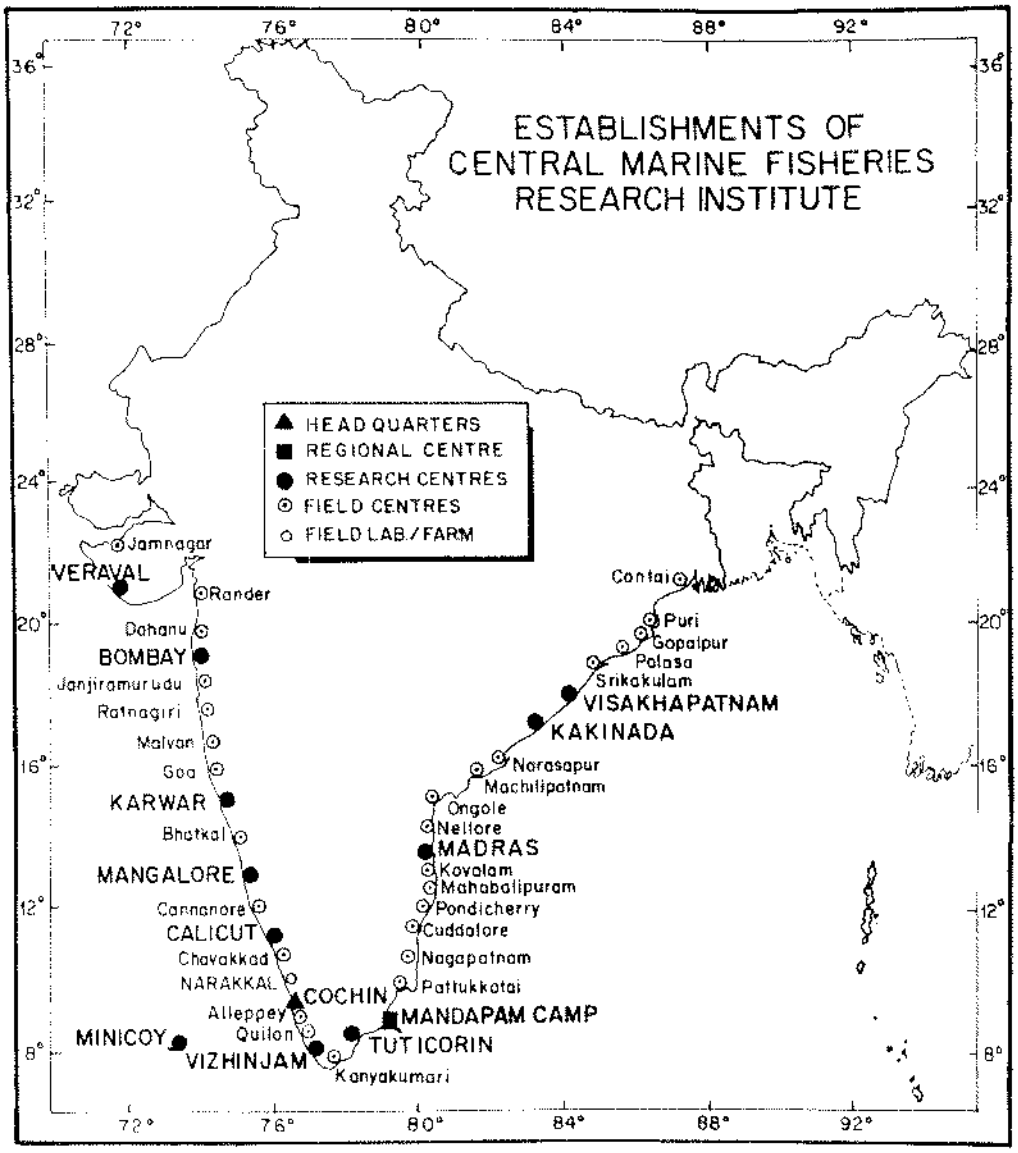
ANNUAL REPORT 1994 - 1995

CENTRAL MARINE FISHERIES RESEARCH INSTITUTE

Indian Council of Agricultural Research



CENTRAL MARINE FISHERIES RESEARCH INSTITUTE

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ANNUAL REPORT
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Indian Council of Agricultural Research
Dr. SALIM ALI ROAD, POST BOX No. 1603, TATAPURAM - P.O.
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Published by

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Director
Central Marine Fisheries Research Institute
Cochin - 682 014

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Dr. N. G. K. Pillai, Senior Scientist

Hindi translation by

Mrs. P. J. Sheela

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Mrs. N. R. Latha Devi

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Cattamaram with sail and OB engine off Kanyakumari

OUR DIRECTOR'S INTRODUCTION

Marine fisheries research has always been a challenging and difficult task. Tropical marine fisheries are essentially multispecies, multigear and open access in their characteristics. Many of the fish landing sites are very remotely located and the fishermen in most cases are illiterates and do not appreciate the difficult task of the fisheries scientist. Tropical fish stocks are distinctly different from their temperate counterparts in their behaviour, migration, food and feeding habits, reproduction, recruitment, growth, mortality and production. It is in this backdrop that the marine fisheries scientists in India carry out their research.

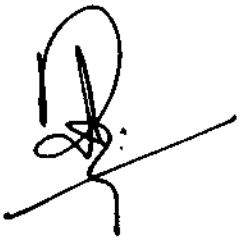
The CMFRI has been by and large very successful in carrying out this responsibility in keeping with its mandate. Yet another year of valuable service in the cause of marine fisheries of the country has been completed and significant contributions have been made in all the programmes undertaken. There were a total of 54 ongoing research projects relating to marine capture and culture fisheries. All of them were being successfully implemented. 5 externally funded projects were also undertaken. The education and training programmes were implemented as per schedule. The total allocated budget of Rs. 836 lakhs (both Plan and Non-Plan) was utilised fully. In spite of the severe constraints due to inadequate funds under T.A. all the programmes were carried out to the best of our ability. This problem was partly managed by utilizing an amount of Rs. 4 lakhs granted by the NRSA to meet a part of the travel cost of the fisheries survey staff of the Institute.

The Institute continued its efforts to strengthen its research activities through various linkages including those with other national organisations with a common interest and purpose. The remote sensing programme at the Institute participated in the collection of sea truth data for the validation of fishery forecast based on potential fishing zone maps. The transfer of technology programmes were effectively continued, with the staff of the Institute actively participating in the various programmes. The Institute adopted the village Chellanam near Cochin for the transfer of the technology of prawn farming following the group concept, and manufacture and marketing of the Institute's Mahima *prawn feed by women*

for their empowerment. The Institute provided consultancy services for: (i) the establishment of a 40-million capacity Penaeus monodon *hatchery to a private entrepreneur in Andhra Pradesh; (ii) monitoring the hydrological and water quality parameters off Cochin for the Cochin Port Trust; and (iii) the identification of areas for coastal aquaculture through site-specific socioeconomic surveys for the Space Application Centre (ISRO), Ahmedabad. The efforts in the generation of data on exploited stocks and fishery environment continued vigorously, stock assessment studies made and the influence of changes in the environment on the availability and abundance of fish in the fishing grounds studied.*

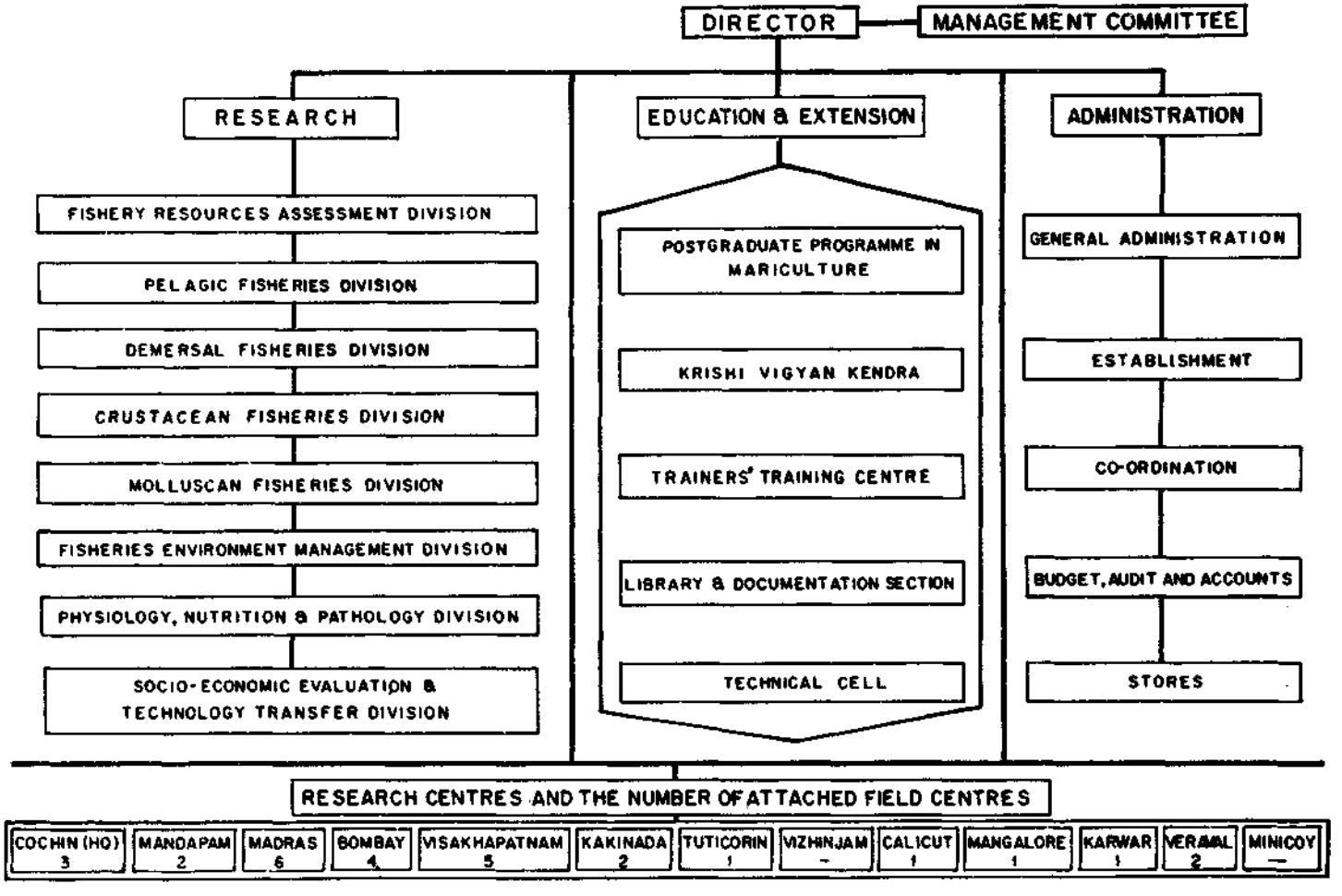
The newly constructed laboratory building of the Institute at Visakhapatnam was occupied and construction of residential quarters at Cochin, Calicut and Minicoy was taken up during the year. The infrastructure facilities for research and for the collection of field data were enhanced by updating the existing facilities. A microearth station linking with the NICNET centres was established at the Institute. About 100 books and over 1000 journals were added to the library at the headquarters and the Institute's publications like the Marine Fisheries Information Service T&E Series, *the* Bulletins *and* Special Publications *containing the results of research work carried out at the Institute were issued during this year also. The staff of the Institute participated in different seminars, symposia and workshops and contributed significantly.*

This Annual Report *presents the details of the progress made in all the activities of the Institute during 1994-'95. I congratulate and thank the Heads of the Divisions, the officers-in-charge of the Research Centres, Scientists, Technical and other staff of the Institute for their contribution to the cause of marine fisheries research in the country.*



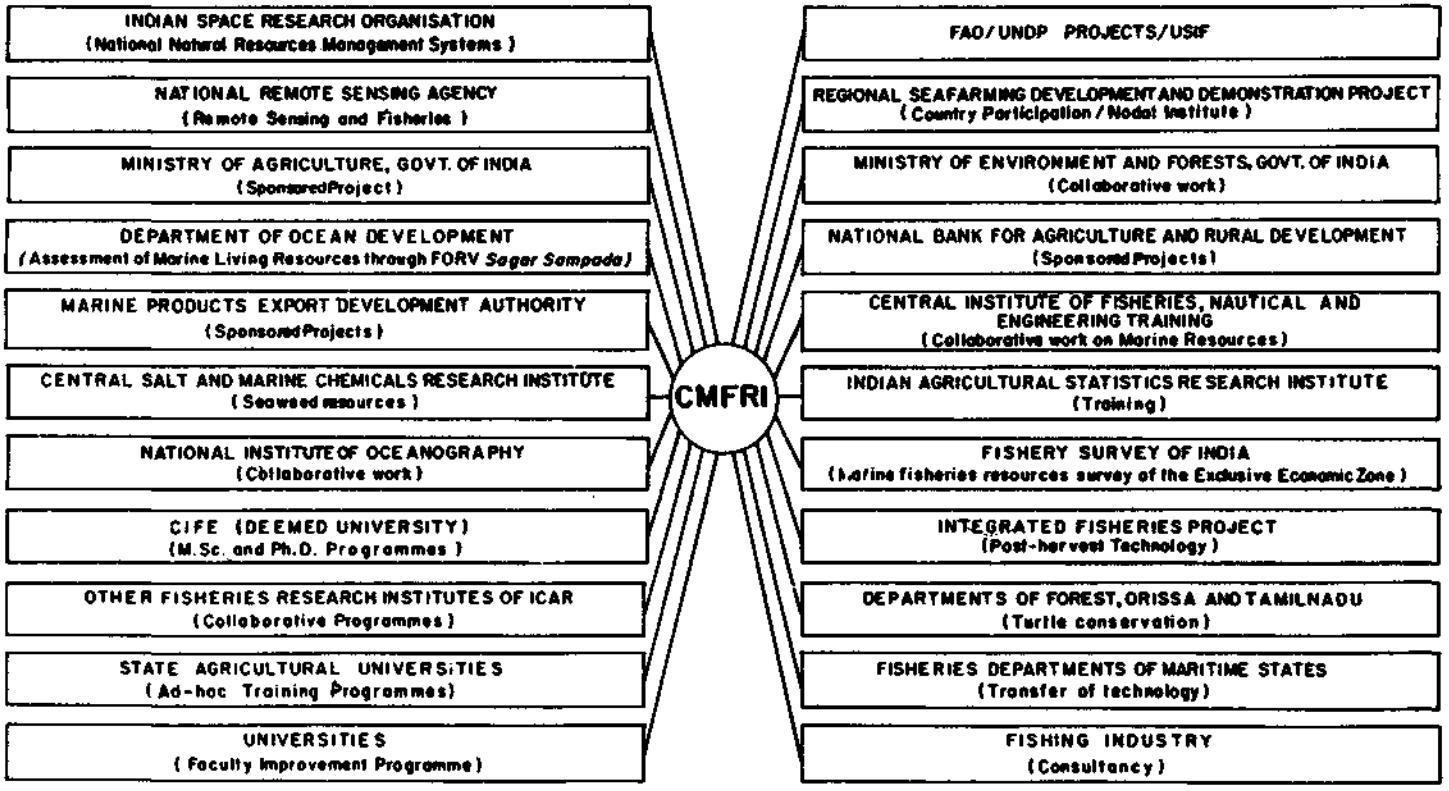
M. DEVARAJ
Director

CENTRAL MARINE FISHERIES RESEARCH INSTITUTE: ORGANISATIONAL CHART



CENTRAL MARINE FISHERIES RESEARCH INSTITUTE, COCHIN
(ICAR)

LINKAGES WITH OTHER ORGANISATIONS



OUR INSTITUTE

Established in 1947 under the Govt. of India and transfered to the Indian Council of Agricultural Research (ICAR) in 1967, the Central Marine Fisheries Research Institute (CMFRI) with its headquarters at Cochin, is one of the eight research organisations in the network of Central Fisheries Research Institutes under the ICAR devoted to Research, Education, Training and Transfer of Technologies in support of development of fisheries in India. The CMFRI is one of the largest marine fisheries research institutes in the world, comparable to the well-established laboratories in U.K., USA, Canada and Japan, capable of carrying out multidisciplinary research in marine capture and culture fisheries. The Institute has well trained R&D staff in areas of fisheries statistics, fisheries biology, stock assessment, physical and biological oceanography, mariculture, economics and extension.

The Mandate

We have the mandate to:

1. Conduct researches on the exploited marine fishery resources aiming at stock assessment, management and conservation
2. assess the under- and unexploited marine fisheries resources of the EEZ
3. understand the influence of variations in the environment on the availability and abundance of fish stocks
4. study the coastal ecology as related to artisanal fishing, endangered ecosystems and pollution
5. develop suitable technologies for seafarming of finfish, shellfish and other cultivable marine organisms
6. study the techno-economics of fishing and sea-farming operations and related social aspects
7. conduct postgraduate teaching programmes leading to M.F.Sc. (Mariculture) and Ph.D. (Mariculture) degress
8. transfer the viable technologies developed; to take up extension education and specialised training programmes and to undertake consultancy services.

To accomplish the above mandate, the Institute conducts researches on characteristics of exploited marine fish stocks; develops seafarming techniques; carries out exploratory surveys and assesses under- and unexploited resources and undertakes to integrate the fluctuations of marine fish production with environmental characteristics and sea-dynamics. Besides, the Institute collects marine fisheries statistics and makes estimation of species-wise landings and monitors the landings on a continual basis from all along the country's coastline. Studies are also conducted on economics of fishery enterprises and socio-economic conditions of fisherfolk.

The organisational set up

To be able to effectively carry out these tasks, the Institute has set up a Regional Centre at Mandapam Camp and Research Centres at Minicoy, Veraval, Bombay, Karwar, Mangalore, Calicut, Vizhinjam, Tuticorin, Madras, Kakinada and Visakhapatnam and 28 Field Centres. The entire activity is coordinated by the Headquarters at Cochin. The Institute has, over the years, built up laboratory and field facilities including computers and research vessels for carrying out research

programmes and has been upgrading the same to meet the changing and additional requirements. The sanctioned staff strength of the Institute is: Scientists 200, Technical 445, Ministerial 172. Supporting 296 and Auxillary 39.

The multi-disciplinary researches in capture and culture fisheries are conducted under eight Divisions: Fisheries Resources Assessment, Pelagic Fisheries, Demersal Fisheries, Crustacean Fisheries, Molluscan Fisheries, Fishery Environment Management, Physiology, Nutrition and Pathology and Socio-Economic Evaluation and Technology Transfer. Inter-divisional and Inter-Institutional programmes with collaborating agencies are carried out for greater utilisation of expertise and facilities. Besides, the Institute also takes up short-term research projects on important and priority areas sponsored by outside agencies in the country and offers consultancy services to the industry. Under the Post-graduate Programme in Mariculture, the Institute organises M.F.Sc. and Ph.D. programmes under affiliation to the Central Institute of Fisheries Education - a Deemed University under the ICAR. The teaching programme is carried out by the Scientists of the Institute.

The Krishi Vigyan Kendra, established in 1976 and the Trainers' Training Centre, impart training in mariculture, agriculture, animal husbandry and other related subjects to fish farmers, agricultural farmers and farm women and to officials of State Governments, Banks, Societies and autonomous bodies interested in fisheries development respectively.

The Library and Documentation section provides reference facilities to research staff and students of the Institute as well as to visiting Scientists both within and outside the country. The results of researches carried out in the Institute are published in various scientific journals, bulletins and special publications and Marine Fisheries Information Service.

OUR BUDGET 1994-95

(Rs. in lakhs)

Account Heads	Non Plan		Plan	
	Budget Estimates	Expenditure	Budget Estimates	Expenditure
Establishment charges	511.22	511.22	-	-
O.T.A.	1.20	1.20	-	-
T.A.	9.80	9.80	5.60	5.60
Works	33.27	32.43	126.67	126.67
Other charges	15.51	16.35	131.17	131.17
Others	-	-	1.56	1.56
Total	571.00	571.00	265.00	265.00

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OUR COMMITTEES

I. MANAGEMENT COMMITTEE

1. The Director — Chairman
   Central Marine Fisheries
   Research Institute
   Cochin-14
2. Dr. K. Radhakrishna — Member
   ADG (Marine Fisheries)
   ICAR, Krishi Bhawan
   New Delhi-1
3. Dr. M.J. Sebastian — -do-
   Dean
   College of Fisheries
   (Kerala Agril. University)
   Cochin
4. Shri Choudhary G.S. Dharasingh — -do-
   House No. VIII/2079
   Palace Road, Cochin-2
5. Engr. Nathu Lal Guljar — -do-
   Krishnan Kunju
   Lal Bagh, Nathdwara
   Dist. Rajasmand
   Rajasthan
6. Shri T.V. Asari — -do-
   Sr. Finance & Accounts Officer
   IIHR, Bangalore
7. Dr. M.S. Rajagopalan — -do-
   Principal Scientist
   CMFRI, Cochin-14
8. Dr. K.A. Narasimham — -do-
   Principal Scientist
   CMFRI, Cochin-14
9. Dr. M.M. Thomas — -do-
   Principal Scientist
   KVK of CMFRI
   Narakkal
10. Shri R. Marichamy — -do-
    Principal Scientist
    Tuticorin Res. Centre of CMFRI
    Tuticorin
11. The Commissioner of Fisheries — Member
    Govt. of Tamil Nadu
    Dept. of Fisheries
    Madras-600 006
12. The Director of Fisheries — -do-
    Govt. of Kerala
    Vikas Bhavan, IVth Floor
    Trivandrum-695 003
13. Shri P. Bapaiah — Member Secretary
    Sr. Adm. Officer
    CMFRI, Cochin-14

II. RESEARCH ADVISORY COMMITTEE

1. Dr. N. Balakrishnan Nair — Chairman
   (Retd.) Chairman
   Dept. of Science & Technology
   Govt. of Kerala
   'SWATHI' Residency Rod
   Thycaud
   Trivandrum-695 014
2. Dr. Arun Parulekar — Member
   Head of Biological
   Oceanography Division
   National Institute of
   Oceanography
   Dona Paula
   Goa-403 004
3. Prof. P. Natarajan — -do-
   Head of the Deptt. of Aquatic
   Biology & Fisheries
   University of Kerala
   Beach P.O.
   Trivandrum-695 007
4. Dr. D. Sudarshan — -do-
   Director General (Retd.)
   Fishery Survey of India
   Botawala Chambers
   Sir P.M. Road
   Bombay

5. Dr. P.S.B.R. James — Member
   Director (Retd.)
   CMFRI, Cochin-14
6. Director, — Member
   CMFRI, Cochin-14
7. Asst. Director General (M.Fy.) — Member
   ICAR, New Delhi
8. Shri Chaudhary G.S. Dhara Singh — Member
   H.N. VIII/2079
   Palace Road, Cochin-2
9. Engr. Nathu Lal Gujar — Member
   Krishnan Kunju, Lal Bagh
   Nathdwara, Dis. Rajsamand
   Rajasthan
10. Dr. K.A. Narasimham — Member Secretary
    Principal Scientist
    CMFRI,
    Cochin-14

III. STAFF RESEARCH COUNCIL

1. Director — Chairman
   CMFRI, Cochin-14
2. Joint Director/Incharge — Member
   Research Coordination &
   Management Unit
   CMFRI, Cochin-14
3. Heads of the Division/Sections — Members
   CMFRI, Cochin-14
4. Principal Investigators of — Members
   ongoing Projects
   CMFRI, Cochin-14
5. Asst. Director General (M. Fy) — Member
   ICAR, Krishi Bhavan
   New Delhi
6. Dr. N.R. Menon — Member
   Director
   School of Marine Sciences
   Cochin University of Science &
   Technology
   Foreshore Road,
   Cochin-16
7. Dr. K. Nagappan Nayar — Member
   Retd. Principal Scientist
   CMFRI
   No. 5, Second Street
   Seetha Nagar
   Madras-34
8. Dr. S.L. Shanbhogue — Member
   Prof. & Head
   Dept. of Fishery Biology
   College of Fisheries
   P.B. No. 527
   Mangalore-575 002
9. Dr. C.S.G. Pillai — Member Secretary
   Principal Scientist
   CMFRI
   Cochin-14

IV. RESEARCH CO-ORDINATION AND MANAGEMENT UNIT

1. Dr. C.S. Gopinadha Pillai — Chairman
   Principal, Scientist
   CMFRI, Cochin-14
2. Dr. V. Sriramachandra Murty — Member
   Sr. Scientist
   CMFRI, Cochin-14
3. Dr. N.G.K. Pillai — Member
   Sr. Scientist
   CMFRI, Cochin-14

V. JOINT COUNCIL

Office side

1. Director — Chairman
2. Shri P. Bapaiah — Member
   Sr. Adm. Officer
3. Shri M.P. Chandrasekharan — Member
   Sr. Finance & Accounts
   Officer
4. Dr. P.P. Pillai — Member
   Principal Scientist

5. Dr. (Mrs.) S. Sivakami — Member
   Sr. Scientist
6. Shri P.A. Naik — Secretary (Official side)
   Asst. Adm. Officer

Staff side

a. Technical Group

1. Shri D. Soundararajan — Member
   Technical Assistant (T-II-3)
2. Shri L. Jayasankaran — Member
   Tech. Asst. (T-I-3)
3. Shri M.P. Sivadasan — Member
   Tech. Asst. (T-I-3)
4. Shri S. Haja Najeemudeen — Secretary (Staff side)
   Sr. Tech. Asst. (T-4)

b. Administrative Group

1. Shri S. Abdulla — Member
   Assistant
2. Shri K.J. Mathew — Member
   Jr. Clerk
3. Shri K. Sadanandan — Member
   Jr. Clerk

c. Supporting Group

1. Shri A.P. Sebastian — Member
   SS Gr. III (Peon)
2. Shri T. Vijayakumar — Member
   (SS. Gr. III (Messenger)
3. Shri B. Zainudeen — Member
   SS. Gr. II (Watchman)

OUR DIVISIONS AND THEIR HEADS

1. Fishery Resources Assessment Division - Shri K. Balan, Scientist SG
2. Pelagic Fisheries Division - Dr. P.P. Pillai, Principal Scientist
3. Demersal Fisheries Division - Dr. P. Bensam, Principal Scientist
4. Crustacean Fisheries Division - Dr. N. Neelakanta Pillai, Senior Scientist
5. Molluscan Fisheries Division - Dr. K.A. Narasimham, Principal Scientist
6. Fishery Environment Management Division - Dr. M.S. Rajagopalan, Principal Scientist
7. Physiology, Nutrition and Pathology Division - Dr. M. Peer Mohamed, Principal Scientist
8. Socio-Economic Evaluation & Technology Transfer Division - Dr. R. Sathiadas, Senior Scientist

OUR REGIONAL/RESEARCH CENTRES AND THEIR OFFICERS-IN-CHARGE

Mandapam Regional Centre of CMFRI Marine Fisheries P.O. Mandapam Camp-623 520 Tamil Nadu Phone: 41443 & 41456	-	Dr. A.D. Diwan Principal Scientist
Veraval Research Centre of CMFRI Bhidiya Plot, Near BMG Veraval-362 267, Gujarat Phone: 20065	-	Dr. K.K. Joshi Scientist
Bombay Research Centre of CMFRI 148, Army & Navy Building 2nd Floor, M.G. Road Bombay-400 001, Maharashtra Phone: 2845260	-	Dr. Kuber Vidyasagar Senior Scientist
Karwar Research Centre of CMFRI Post Box No. 5 Karwar, North Kanara, Karnataka Phone: 26371 & 26165	-	Dr. V.S. Kakati Senior Scientist
Mangalore Research Centre of CMFRI Post Box No. 244, Bolar Mangalore-575 001 Dakshina Kanara, Karnataka Phone: 24152	-	Shri C. Muthiah Scientist (SG)
Calicut Research Centre of CMFRI West Hill P.O. Calicut-673 005, Kerala Phone: 50377	-	Dr. P.S. Kuriakose Principal Scientist
Vizhinjam Research Centre of CMFRI Vizhinjam P.O. Trivandrum-695 521, Kerala Phone: 480224	-	Dr. P.A. Thomas Senior Scientist
Tuticorin Research Centre of CMFRI 90, North Beach Road Tuticorin-628 001 Tamil Nadu Phone: 20274	-	Shri R. Marichamy Principal Scientist

Madras Research Centre of CMFRI 68/1, 4th Floor, Greams Road Madras-600 006, Tamil Nadu Phone: 8254252 & 8253299	-	Dr. K. Satyanarayana Rao Principal Scientist
Kakinada Research Centre of CMFRI Door No. 8-14-18/2 Red Cross Street, Gandhi Nagar Kakinada-533 004, Andhra Pradesh Phone: 76231	-	Shri G. Subbaraju Principal Scientist
Visakhapatnam Research Centre of CMFRI Andhra University P.O. Visakhapatnam-530 003 Andhra Pradesh Phone: 543793 & 63779	-	Dr. V.S.K. Chennubhotla Principal Scientist
Minicoy Research Centre of CMFRI Minicoy, U.T. of Lakshadweep Phone: 22228, 22263	-	Shri M. Sivadas Scientist (SS)
Krishi Vigyan Kendra of CMFRI Prawn Culture Farm Narakkal-682 505 Ernakulam Dist., Kerala Phone: 492482, 492450	-	Dr. D. Noble Sr. Scientist
Field Lab of CMFRI Cochin Fisheries Harbour Thoppumpady Cochin-682 005, Kerala Phone: 230892	-	Mrs. Grace Mathew Scientist (SG)

OUR FIELD CENTRES

Alleppey Field Centre of CMFRI
Geetha Building, Kalarcode
Alleppey-688 003, Kerala

Bhatkal Field Centre of CMFRI
1st Floor, Behind Ganesh Bhavan Building
27, Kidwai Road
Bhatkal (N.K.)-581 320

Chavakkad Field Centre of CMFRI
Chavakkad P.O. 680 506
Trichur District, Kerala

Contai Field Centre of CMFRI
Thanapukurpar, P.O. Contai 721 401
Midnapore District, West Bengal

Cuddalore Field Centre of CMFRI
Jawan's Bhavan
Lawrence Road
Cuddalore-607 002

Dahanu Field Centre of CMFRI
Kirtane Bungalow, Mangailwada
Dahanu, Thana District
Maharashtra

Goa Field Centre of CMFRI
Shri P.R. Phal House
1st Floor, B.B. Borkar Road
Alto-Porvorim-403 521
Bardez, Goa

Gopalpur Field Centre of CMFRI
Gopalpur-on-sea (P.O.)
Ganjam Dist., Orissa

Jamnagar Field Centre of CMFRI
Milan Chambers, Khodiyar Colony
Aerodrome Road
Jamnagar-361 006, Gujarat

Janjira Murud Field Centre of CMFRI
14/3, Bazar Peth Road
Ground Floor
Janjira Murud-402 401
Raigad District, Maharashtra

Kannur Field Centre of CMFRI
Office of the Deputy Director of Fisheries
Moppila Bay Fisheries Complex
District Hospital Post
Kannur-670 017

Kanyakumari Field Centre of CMFRI
Kanyakumari-629 702
Tamil Nadu

Kovalam Field Laboratory of CMFRI
Kovalam-602 112
Chengulpet Dist
Tamil Nadu

Machilipatnam Field Centre of CMFRI
17/299, Sidimbi Agraharam Lane
Machilipatnam-521 002
Andhra Pradesh

Mahabalipuram Field Centre of CMFRI
Mahabalipuram-603 104
Tamil Nadu

Malwan Field Centre of CMFRI
2799/2, Dawoolwada, Pawar Chal
Malwan-416 606, Maharashtra

Narasapur Field Centre of CMFRI
Door No. 2-5-5/1
Vanisadan
Bromly Compound
Narasapur-534 275
West Godavari District
Andhra Pradesh

Nagappatinam Field Centre of CMFRI
C/o Inspector of Fisheries
Salt Road
Nagapattinam-611 001
Thanjavur Dt., Tamil Nadu

Nellore Field Centre of CMFRI
Room No. 14, Municipal Building
New A.C. Bubba Reddy Statue
Weyyalakalava Street
Nellore-524 001, Andhra Pradesh

Ongole Field Centre of CMFRI
No. 49, A.P. Housing Colony
Manidipakam
Ongole-523 002
Prakasam District
Andhra Pradesh

Palasa Field Centre of CMFRI
K.T. Road (Near Ravi Electricals)
Palasa, Srikakulam District
Andhra Pradesh

Pattukottai Field Centre of CMFRI
Room No. 23,
Periaswamy Building
187/A, Big Bazar Street
Pattukottai-614 601,
Tanjore

Pondicherry Field Centre of CMFRI
C/o Deputy Director of Fisheries
190-Chinnasubrayalu Street
Pondicherry-605 001

Puri Field Centre of CMFRI
Santikunja Lane
Near Hotel Sea 'n' Sand
Chakratirtha Road
Puri-752 002, Orissa

Quilon Field Centre of CMFRI
Muncipal Stadium Buildings
Ward No. VII, Door No. 737
Quilon, Kerala

Rander Field Centre of CMFRI
II Floor, 'Devikripa'
3/213, Bandariward
Rander, Surat-395 005

Ratnagiri Field Centre of CMFRI
Building No. 3615, Devchand Nivas
Lower Lane, Ratnagiri-415 612
Maharashtra

Srikakulam Field Centre of CMFRI
Door No. 8-15-68, Ring Road
Near Head Post Office
Srikakulam-532 002

OUR STAFF DEPUTED ABROAD

1. Dr. Veerendra Veer Singh, Scientist, to Thailand for attending training course in the field of integrated coastal management "Special Area Management Planning" during 10-30 April, 1994.

2. Dr. K. Sunilkumar Mohamed, Scientist to France to attend three months training from 12-9-'94 to 11-12-'94 under DBT.

3. Dr. G. Maheswarudu, Scientist, to USA for availing long term overseas Associateship under DBT for the period from 26-1-'95 to 25-1-'96.

4. Shri S. Kalimuthu, Technical Officer and Shri J.R. Ramalingam, Technical Assistant, to Bangkok to attend Final Workshop on the Taxonomy, Ecology and processing of commercially important Red Seaweeds from 26-1-'95.

5. Mrs. Mary K. Manissery, Scientist (SG) to Australia for attending training in Shrimp Pathology at University of Queensland, Brisbane for the period from 25-1-'95 to 2-8-'95.

OUR EDUCATION PROGRAMME

Under the post graduate programme in mariculture 5 candidates who worked under the guidance of Drs. K. Rengarajan, K.J. Mathew, P.S.B.R. James, N. Gopalakrishna Pillai and M. Peer Mohammed were awarded Ph.D. degrees by the Cochin University of Science and Technology. The subjects of investigations included effect of heavy metal concentration in mullets, coral erosion, coral reef fishes, sea cucumbers and metabolic adaptations of sea bass. Four candidates of the earlier batch also submitted Ph.D. theses to Cochin University. During the academic year under report, 29 students were on the roll for research work/course work. Ten of them were for Ph.D. degree of which six registered with Cochin University have progressed well in their research work which dealt with reproductive endocrinology, chemoreception in relation to growth, genotoxicity and nutritional and pathological aspects of finfish and shellfish and mud crab culture. Four new Ph.D. scholars who joined under Deemed University regulation have completed the I semester course work. In the M.Sc. degree programme, a batch of 10 students are undergoing deficiency course and another batch of 9 the regular course; they have completed their I semester course work.

OUR STAFF DEPUTED ABROAD

1. Dr. Veerendra Veer Singh, Scientist, to Thailand for attending training course in the field of integrated coastal management "Special Area Management Planning" during 10-30 April, 1994.

2. Dr. K. Sunilkumar Mohamed, Scientist to France to attend three months training from 12-9-'94 to 11-12-'94 under DBT.

3. Dr. G. Maheswarudu, Scientist, to USA for availing long term overseas Associateship under DBT for the period from 26-1-'95 to 25-1-'96.

4. Shri S. Kalimuthu, Technical Officer and Shri J.R. Ramalingam, Technical Assistant, to Bangkok to attend Final Workshop on the Taxonomy, Ecology and processing of commercially important Red Seaweeds from 26-1-'95.

5. Mrs. Mary K. Manissery, Scientist (SG) to Australia for attending training in Shrimp Pathology at University of Queensland, Brisbane for the period from 25-1-'95 to 2-8-'95.

OUR EDUCATION PROGRAMME

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OUR KRISHI VIGYAN KENDRA

1. Training:

KVK Narakkal gives training for practising farmers, rural youths, school dropouts village women and extension workers of development departments. During the year 1994-95, 9 training courses were conducted for practising farmers and 230 persons were trained of which 47 were women. 23 training courses were conducted for rural youths, village women and school dropouts on subjects related to Fisheries, Animal production, Horticulture and Home Science. A total 377 women were trained during these courses. 2 training courses were conducted for extension workers and 27 persons were trained in prawn farming of which 20 were women.

2. Lab to Land programme (First line demonstration)

Lab to land programme was implemented in Nayarambalam vilage in Vypeen block and Ezhidara village in North Parur block for 100 families selected based on Bench mark survey. Based on the survey, farm plan was prepared and critical inputs like prawn seeds, fish seeds, sluice gate, coconut seedings, fertiliser, pesticide and chicks were distributed.

3. SC/ST Programme (On farm research)

The programme was implemented for 56 families selected from Narakkal village. Based on the bench mark survey, the families were divided into 3 groups based on the resource available with them. Group A is mainly for prawn farming, Group B for horticulture and Group C for animal production. Critical inputs were distributed for each group in an integrated manner. Home science aspect was included in all the groups. The inputs given were prawn seeds, coconut saplings, vegetable seeds, inputs for fish processing units, chicks, fertiliser and pesticide.

4. Extension activities

During the period 3 field days and 4 kisan melas at Narakkal, Edavanakad and Elankunnapuzha village of Vypeen block and 1 at Chellanam village were conducted 1 Science camp for VHSC students of Govt. Higher Secondary School, Narakkal was held. 3 radio talks were broadcast over AIR Trichur on (a) Training facilities at KVK, Narakkal (b) Pest control in prawn farms and (c) Fresh water prawn farming. 2 project reports were prepared and given to the farmers to avail bank loan to develop prawn farming.

OUR TRAINERS' TRAINING CENTRE

The Trainers' Training Centre (TTC) under the Institute is engaged in offering training to officials of State Government, Banks, Societies and autonomous bodies interested in fisheries development. During the year, following training courses were organised and conducted:

SCHEDULE OF TRAINING COURSES ORGANISED DURING 1994-'95

Sl. No.	Subject	No. of Courses organised	Duration (Days)	No. of Participants
1.	Hatchery production of marine prawn seeds	1	15	7
2.	Prawn farming	1	10	12
3.	SCUBA Diving	1	45	7
4.	Sampling techniques for assessment of exploited marine fisheries resources	1	10	6
5.	Pearl culture	1	20	6
6.	Hatchery technology for pearl oyster seed production	1	20	4
	Total	6	120	42

OUR LIBRARY AND DOCUMENTATION SECTION

During the year under report, 101 new books and 2067 issues of of journals were added to the library at the Headquarters. Essential books and periodicals were also acquired for the libraries at the Mandapam Regional Centre and all the other Research Centres. Iner-library collaboration and inter-library loan of publications were continued. Reference facilities were provided to visiting scientists, scholars and students of various universities, Institutions and others from within and outside the country.

The library also stocks, distributes and sells the Institute's publications. Sale of CMFRI Bulletins, Special Publications and Indian Journal of Fisheries was also made during the period.

The following publications were issued:

1. *CMFRI Special Publication* No. 60
2. *CMFRI Bulletin* Nos. 46 & 47
3. *Marine Fisheries Information Service, Technical and Extension Series*, Nos. 127-135
4. *CMFRI Newsletter* Nos. 61-64
5. *Research Highlights* 1993-94
6. *CMFRI Annual Report* 1993-94
7. Institute Brochure

OUR CONSULTANCIES

The CMFRI provides consultancy services and R&D support in various aspects of marine capture and culture fisheries in order to utilise the Institutes expertise in assisting the entrepreneurs, governmental and private agencies and, in return to generate funds for the Institute. During the year, three consultancies were taken up.

In the consultancy on penaeid prawn hatchery, a 40 - million seed capacity hatchery was designed, construction work completed and phytoplankton culture and rematuration facilities were tested successfully for the hatchery of a private entrepreneur at Chirala, Andhra Pradesh.

In another programme, the Institute carried out consultancy to Cochin Port Trust in assessing the effect of dredging in the harbour area for the Reclamation Project in Wellingdon Island. Data on 16 parameters from 3 stations are collected regularly from January '94.

In yet another programme, the Institute initiated consultancy work in January 1995 for the SAC (ISRO) for conducting socio-economic surveys at selected sites in Ernakulam and Thrissur districts of Kerala.

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THE OFFICIAL LANGUAGE IMPLEMENTATION PROGRAMME

During 1994-95, a total of 213 letters were received in Hindi of which 104 were replied in Hindi; reply was not required for the remaining 109 letters. All the documents coming under Section 3(3) of the OL Act 1963, such as general orders, rules, notification, tender notices, administrative and other reports were issued in bilingual form; a total of 636 documents of this category were issued from headquarters.

During the year under report 17 staff members passed the various courses under Hindi and two persons underwent the translation course.

Regular meetings of the Official Language Implementation Committees at Headquarters as well as Research Centres were conducted and progress in implementation monitored.

Two meetings of the Cochin TOLIC were held which were attended by Dr. P. Vedavyasa Rao, Director and Dr. K. Alagaraja, Principal Scientist.

Two Hindi Workshops were organised and a total of 37 employees were trained.

In the workshop organised at CIFE, Bombay 2 scientists of CMFRI S/Shri K.R. Manmadhan Nair and T.S. Velayudhan participated and presented papers in Hindi.

Hindi week was celebrated at headquarters and Research Centres from 7-9-'94 to 14-9-'94 by organising competitions and cultural programmes.

Four Hindi posts were created and one post of Hindi Translator was filled up. Recruitment action was taken for filling up the other posts.

The Veraval Research Centre of CMFRI was notified in the official Gazette under Rule 10(4) of OL Act.

The following publications of the Institute were released in Hindi/English.

(1) CMFRI Annual Report with Hindi summary

(2) CMFRI Research Highlights 1993-94 in bilingual form

(3) CMFRI Newsletter (quarterly) in bilingual form

(4) MFIS (Monthly) in bilingual form

(5) CMFRI Brochure in Hindi and English separately

The effort of CMFRI in Hindi implementation was appreciated by the Deptt. of Official Language, Ministry of Home Affairs and the Institute was awarded a trophy from this department in recognition of the progress made in Hindi implementation programme.

OUR PROGRESS IN RESEARCH

I. Fishery Resources Assessment Division

Assessment of Exploited Marine Fishery Resources (FSS/FRA/1.1)

K. Balan, K. Alagaraja, K.S. Scariah, M. Srinath T.V. Sathianandan and K. Vijayalekshmi

The exploitation in the inshore areas continued as usual during 1994 and there was targetted effort for shrimp, cephalopods and certain other economically important varieties.

Marine Fish Production in India During 1994

The total marine fish landing in the country was provisionally estimated at 2.36 million t as against 2.28 million t of 1993. An increase of 3.5% (80,000 t) over 1993 was observed. Pelagic groups contributed 46.7% and demersal groups 53.3%. The mechanized and motorized units together contributed 86.5% of the total landings and the rest by traditional units.

Table 1. Regionwise marine fish production (in tonnes) in India during 1994

Region	Estimated landings	% in the all India total landings
1. North east (West Bengal and Orissa)	109,100	4.6
2. South east (Andhra, Tamil Nadu and Pondicherry)	579,027	24.5
3. South west (Kerala, Karnataka and Goa)	779,494	33.1
4. North west (Maharashtra and Gujarat)	857,525	36.4
5. Lakshadweep & Andamans	33,088*	1.4*

* Provisional

Though there was an increase of about 80,000 t in the landings, the catches of oil sardine, whitebait and mackerel decreased by 49,000 t, 12,000 t and 45,000 t respectively. However, the landings of croakers, ribbonfishes, carangids, penaeid prawns and cephalopods increased by 37,000 t, 21,000 t, 10,000 t, 51,000 t and 17,000 t respectively.

North east region

Compared to the landings of 1993, a reduction of 45,000 t was noticed. Principal components that showed declined landings are Elasmobranchs, Catfishes, Hilsa shad, Bombay duck, Penaeid prawns and Non-penaeid prawns. The landing of Elasmobranchs was 3,000 t in 1994 and a reduction of about 2,700 t was noticed. Catfish landings reduced by 3,000 t with an estimate of 9,000 t. The estimate of 24,000 t of Hilsa, recorded a reduction of 4,000 t, compared to 1993. The estimated landing of Bombay duck was about 7,000 t in 1994 which showed a decrease of 14,000 t over 1993. Penaeid and Non-penaeid prawn landings declined by 2,000 and 1,000 t, the estimated landings being 4,000 t and 2,000 t respectively in 1994.

South east region

The marine fish landings in 1994, along south east region, registered an increase of 63,000 t over 1993. The prominent groups which registered increased landings were oil sardine, whitebaits, carangids, silver bellies, mackerel, penaeid prawns and cephalopods. Oil sardine landings were estimated at 43,000 t which showed an increase of 3,000 t. The landings of whitebait, carangids, silver belllies, mackerel, penaeid prawns and cephalopods were estimated at 16,000 t, 33,000 t, 59,000 t, 34,000 t, 46,000 t and 17,000 t respectively, which registered increases of 3,000, 11,000, 8,000, 8,000, 10,000 and 7,000 t respectively.

South west region

The total landings in this region showed a decline of about 60,000 t over those of 1993.

Major contributors to the decline were oil sardine, whitebait and mackerel. However, landings of penaeid prawns, ribbonfishes and cephalopods recorded increased landings.

With the estimated landing of about 3,000 t in 1994 which showed a decline of 52,000 t over 1993, the oil sardine fishery along south west coast was almost a total failure. The landing of *Stolephorus* spp. was 42,000 t in 1994 as against 57,000 t of 1993. A decline of 8,000 t was noticed in the landings of perches, the estimated landing during the year being 73,000 t; the major contributor for this decline was threadfin breams. Carangids contributed 73,000 t which was 25,000 t less than the estimate of 1993. Mackerel landing was 147,000 t in 1994 and a reduction of 30,000 t was noticed during the year.

The landings of ribbonfishes showed an improvement of 14,000 t in 1994 the estimate being 25,000 t. The increase in the landing of penaeid prawns was 28,000 t with the annual estimated value in 1994 at 83,000 t. Cepehalopod catch was 48,000 t which showed a slight increase of 3,000 t over 1993.

North west region

The landings in this region registered an increase of 121,000 t over 1993. The prominent groups which contributed to the increased production were Bombay duck, croakers, ribbonfishes, catfishes, perches, carangids, mackerel, penaeid and non-penaeid prawns and cephalopods.

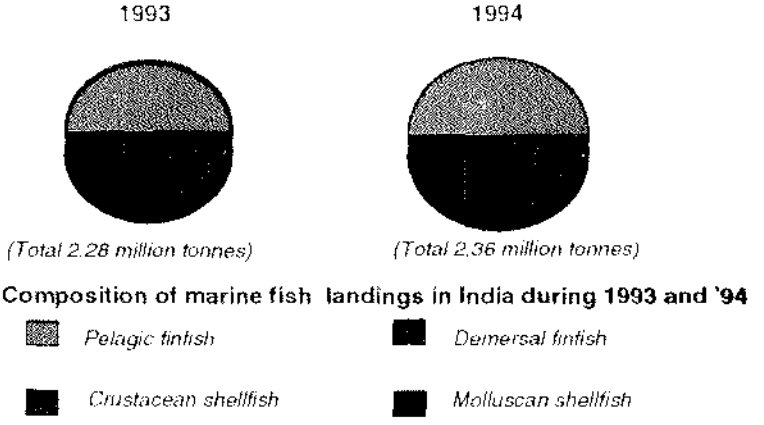
The Bombay duck fishery of this region contributed 102,000 t which showed an increase of 26,000 t. The landings of croakers, ribbonfishes, catfishes, perches, carangids, penaeid prawns, non-penaeid prawns and cephalopods were respectively 132,000 t, 73,000 t, 30,000 t, 31,000 t, 28,000 t, 91,000 t, 67,000 t and 49,000 t; these groups registered increases of 37,000 t, 10,000 t, 6,000 t, 3,000 t, 12,000 t, 15,000 t, 2,000 t and 7,000 t respectively over 1993.

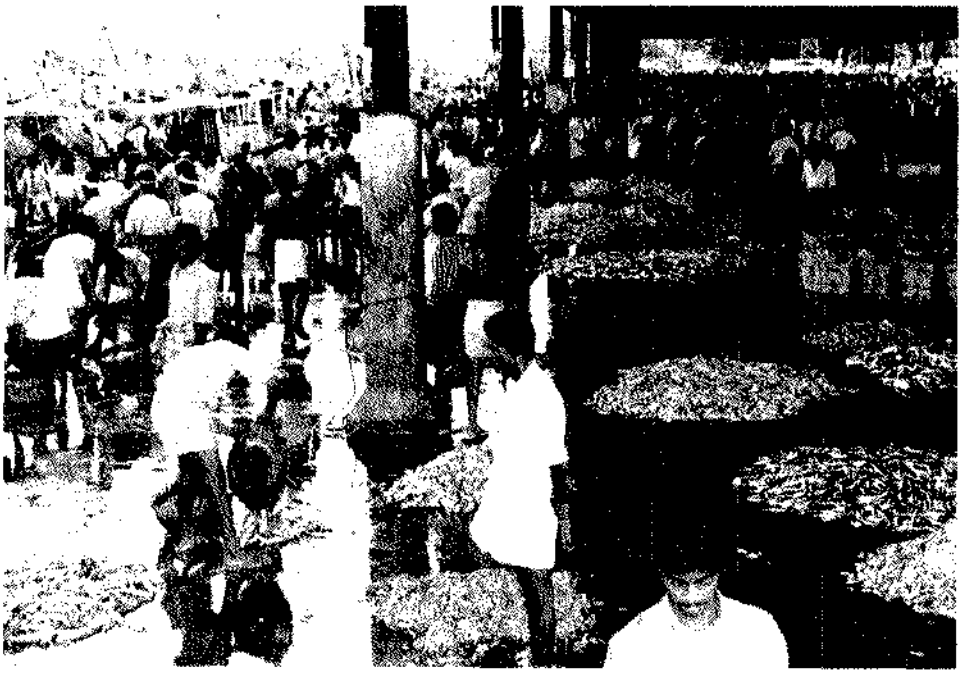
The landing of pomfrets was estimated at 15,000 t which was less than that obtained in 1993.

CONTRIBUTION OF PELAGIC FISHES

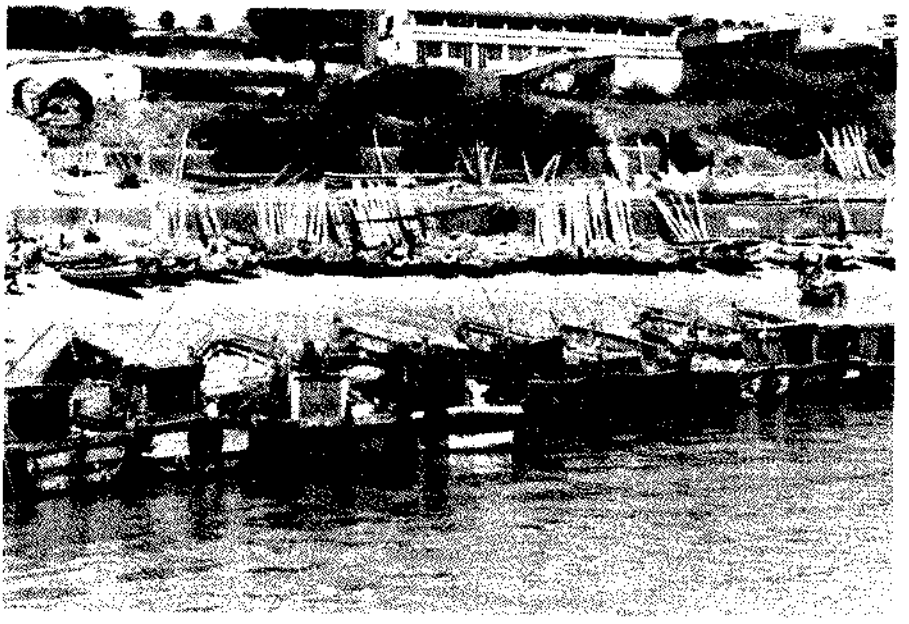
Oil Sardine: The oil sardine fishery suffered a set back in this year. The landings accounted a mere 1.99% of the total marine fish production of the country and 4.2% of the pelagic fish landings (Table 2). The estimate of oil sardine landings in the country was at 47,000 t during 1994 which was 48,000 t less than that of 1993. This decline is mainly because of the failure of the fishery at the major production region, the southwest coast; a decline of 52,000 t over 1993 was recorded. Only an estimated 3,000 t of this species were landed in this region.

Mackerel: Mackerel landings accounted for 8.7% of the total production and 18.7%

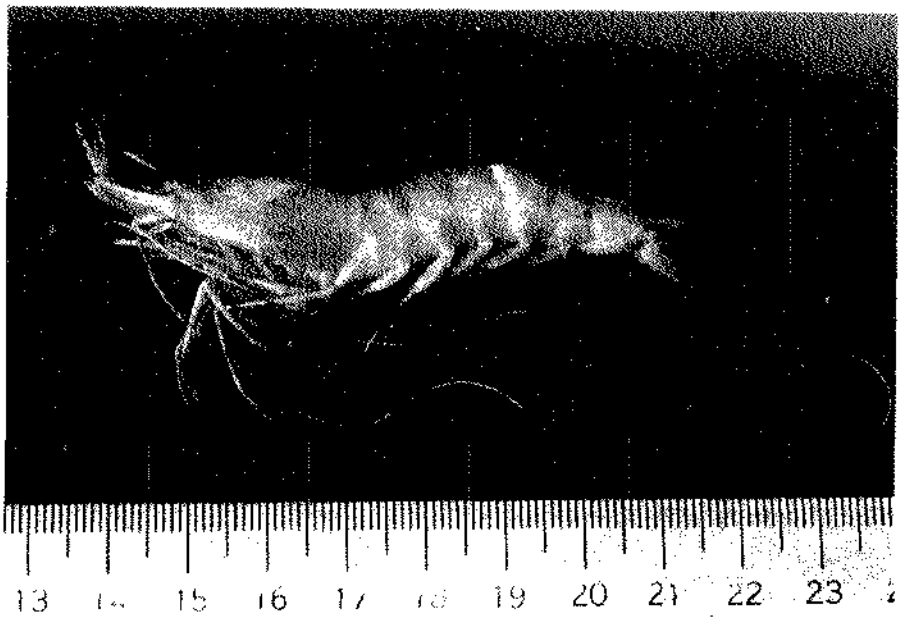




Landings at the Cochin Fisheries Harbour



Landing centre at Kanyakumari showing IB and OB units



Trachypenaeus curvirostris - an emerging deep sea prawn resource

of the pelagic fish catch. The mackerel fishery also recorded reduced landings over 1993. A reduction of 45,000 t during 1994 was noticed; the estimate during 1994 was 206,000 t. The decline in the landings was primarily noticed in the south west region.

Whitebait: The landings accounted for 2.5% of the total marine production and 5.4% of the pelagic group of the country. The landings were estimated at 59,000 t in 1994 and a reduction 12,000 t noticed.

Bombay duck: Bombay duck landings accounted for 4.6% of the total marine fish production of the country which worked out to 9.9% of the pelagic group. Bombay duck landing was 109,000 t which showed an increase of 12,000 t.

Carangids: These fishes formed 5.9% of the total marine fish production and 12.6% of the pelagic fish catch. The landing during 1994 was 139,000 t which showed an increase of about 10,000 t.

Ribbonfish: The landings of ribbonfishes accounted for 4.8% of the total marine fish production of the country and 10.2% of the pelagic fish catch. An increase of 21,000 t was noticed in the landings of ribbonfishes, the production during 1994 being 113,000 t.

Tunnies: Tuna landings accounted for 1.6% of the total marine fish production and 3.3% of the pelagic fish catch. The estimate for 1994 was 37,000 t which showed a reduction of 7,000 t, compared to 1993.

Contribution of Demersal Fishes

Catfishes: Catfish landings accounted for 1.9% of total marine fish catch and 3.6% of the demersal landings. The estimate was 45,000 t in 1994 which showed a slight increase of 2,000 t.

Elasmobranchs: This group accounted for 2.4% of the country's production and 4.6% of the demersal fish catch. An estimate of 58,000 t was recorded in 1994 which was 9,000 t less than that obtained in 1993.

Perches: The landings of perches accounted for 6.2% of the total marine fish production and 11.6% of demersal fish catch. The estimated landings of perches was 145,000 t in 1994 which showed a decline of about 4,000 t.

Croakers: The landings of croakers was 196,000 t in 1994 which showed an increase of 37,000 t. The landings accounted for 8.3% of total marine fish production and 15.6% of the demersal catch.

Pomfrets: Pomfret landing was 37,000 t during 1994 which showed a reduction of 4,000 t; the landings accounted for 1.6% of the total marine fish landings of the country and 3.0% of the demersal fish landings.

Contribution of Shellfishes

Cephalopods: Cephalopod landing during 1994 was 114,000 t which showed an increase of 17,000 t. They accounted for 4.8% of the total marine fish production and 9.1% of demersal fish catch.

Penaeid prawns: The penaeid prawn landings accounted for 9.5% of the total marine fish production of the country and 17.8% of the demersal fish catch. The landings showed an increase of 51,000 t in 1994, the estimate being 225,000 t.

Non-penaeid prawns: The landings of non-penaeid prawns was 74,000 t in 1994 which showed an increase of 4,000 t. Non-penaeid prawn landings accounted for 3.1% of the total marine fish catch of the country and 5.8% of the demersal catch.

LANDINGS BY MECHANIZED AND NON-MECHANIZED UNITS

Mechanized units accounted for 86.5% of the total marine landings of the mainland in 1994. Compared to 1993, there was a slight upward trend of about 1% in the landings of mechanized units. The units are categorized into three groups: *category I* units having mechanical power for propulsion as well as, fishing: *category II* units having power for propulsion alone and *category III* artisanal units having no mechanical power either for propulsion or for fishing. Category I units contributed 1,400,000 t (60.3%) to the total production whereas category II accounted for 26.2%. The production of category I

Table 2. Estimated landings (in tonnes) of pelagic fishes in India during 1993 and 1994

Name of fish	1993	1994*
Clupeoids		
Wolf herring	17511	16667
Oil sardine	95385	46814
Other sardines	88781	87160
Hilsa shad	30215	25826
Other shads	12346	25510
Coilia	30164	32327
Setipinna	2359	1546
Stolephorus	71925	59981
Thrissina	5	8
Thryssa	34302	37787
Other clupeoids	43175	53870
Bombay duck	97727	109307
Half beaks and Full beaks	2300	2655
Flying fishes	1654	219
Ribbonfishes	91671	112648
Carangids		
Horse mackerel	16074	24698
Scads	59505	49559
Leather-jackets	4151	5105
Other carangids	49615	59652
Mackerels		
Indian mackerel	251141	206135
Other mackerels	5	22
Seerfishes	-	-
S. commersoni	20019	24504
S. guttatus	21630	16244
S. lineolatus	79	46
Acanthocybium spp.	1	-
Tunnies	-	-
E. affinis	19197	15754
Auxis spp.	3976	12502
K. pelamis	8761	584
T. tonggol	4324	4834
Other tunnies	7698	2595
Billfishes	1810	1479
Barracudas	11410	10141
Mullets	4906	9281
Unicorn cod	929	430
Miscellaneous	48353	46120
Total pelagic	1153104	1102587

* Provisional, as the estimated landings of Andamans and Lakshadweep are not final.

Table 3. Estimated landings (in tonnes) of demersal finfish and shellfish in India during 1993 and 1994

Name of fish	1993	1994*
Elasmobranchs		
Sharks	46781	37520
Skates	1549	2040
Rays	18869	18153
Eels	6725	5994
Catfishes	43110	45161
Lizardfishes	25607	32003
Perches		
Rock cods	10895	9449
Snappers	3088	3450
Pig-face breams	6990	9705
Threadfin breams	86970	80936
Other perches	41453	41917
Goatfishes	13856	12223
Threadfins	5851	8165
Croakers	158794	196329

Silverbellies	62433	69941
Big-jawed jumper	4189	5820
Pomfrets		
Black pomfret	12727	13779
Silver pomfret	28403	23340
Chinese pomfret	940	1132
Flatfishes		
Halibut	1802	2708
Flounders	182	322
Soles	44678	41168
Crustaceans		
Penaeid prawns	173432	224852
Non-penaeid prawns	69221	73500
Lobsters	1671	2692
Crabs	27037	29631
Stomatopods	86499	98052
Molluscs		
Cephalopods	96900	113979
Miscellaneous	44456	51686
Total Demersal	1125108	1255647

* Provisional, as the estimated landings of Andamans and Lakshadweep are not final.

units increased by about 130,000 t but that by category II units reduced by 40,000 t. Non-mechanized units (category III) contributed only 314,000 t which showed a slight reduction of 4,000 t compared to that of 1993.

Table 4 gives the percentage contribution by different categories of units to the total production of each region. North east region recorded a similar trend in the distribution of catch in the three categories as that of 1993; maximum contribution was from category II units (58.6%). In the south east region, a slight improvement in the production of category I and category II units noticed. Non-mechanized units contributed slightly less (3%). In the south west coast maximum production was from category I units (65.8%) during 1994. The trend is similar to that of 1993. However, the contribution of category I units along north west coast increased by 8% and by the contribution of category II units decreased by about 8%.

In the landings by each category of units in the country as a whole (Table 5), the mechanized units (category I) contributed maximum landings in the north west region, the motorised units (category II) in the south west region and the artisanal units (category III) in the south east region. When compared to the situation in previous year, one would notice that there was substantial reduction along southwest coast in regard to contribution of category I and a similar increase in the same along north west region.

Table 4. Percentage contribution of landings of different categories of units to the total production of each region during 1993 and 1994

Region	1993 Category			1994 Category		
	I	II	III	I	II	III
1. North east	24.4.	58.6	17.0	25.7	58.6	15.7
2. South east	51.5	14.0	34.3	53.2	15.8	31.0
3. South west	66.1	29.0	4.9	65.8	30.7	3.5
4. North west	56.2	33.6	10.2	64.3	25.2	10.5

Table 5. Percentage contribution of landings of different regions to the total of each category of units

Region	1993 Category			1994 Category		
	I	II	III	I	II	III
1. North east	2.9	13.9	8.2	2.0	10.5	5.4
2. South east	20.9	11.0	55.4	22.0	15.0	57.1
3. South west	43.7	37.3	13.0	36.6	39.2	8.8
4. North west	32.5	37.8	23.4	39.4	35.3	28.7

Table 6. Effort (1000 unit operations), Catch (tonnes) and CPUE (Kg) of each category of units along different regions in 1993 and 1994

Region	Category	1993			1994		
		Effort	Catch	CPUE	Effort	Catch	CPUE
North east	I	121	37,581	311	92	28,025	306
					(-24.0)	(-25.5)	(-1.6)
	II	253	90,350	356	342	63,978	187
					(+35.2)	(-29.2)	(-47.5)
	III	494	26,319	53	319	17.097	54
					(-35.4)	(-35.0)	(+1.9)
South east	I	671	264,904	395	718	308,034	429
					(+7.0)	(+16.3)	(+8.6)
	II	1046	72,097	69	1292	91,576	71
					(+23.5)	(+27.0)	(+2.9)
	III	4508	177,150	39	4300	179,417	42
					(-4.6)	(+1.3)	(+7.7)
South west	I	932	554,402	595	1035	513,041	495
					(+11.1)	(-7.5)	(16.8)
	II	1306	242,992	186	1300	239,055	184
					(-0.5)	(+23.1)	(-1.1)
	III	1239	41,712	34	1007	27,398	27
					(-18.7)	(-34.3)	(-20.6)
North west	I	381	412,726	1085	414	518,268	1252
					(+8.7)	(+25.6)	(+15.4)
	II	966	246,465	255	959	236,309	246
					(-0.7)	(-4.1)	(-3.5)
	III	363	74,910	206	302	90,348	299
					(-16.8)	(+20.6)	(+45.1)

Values in parentheses are percentages of increase or decrease over 1993

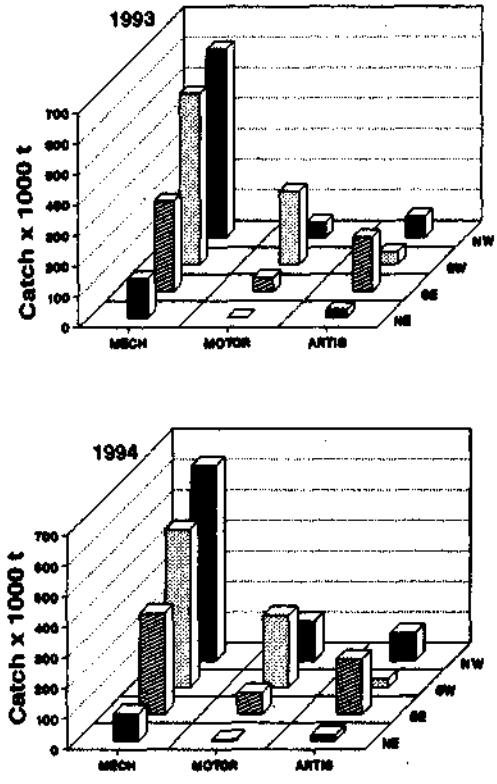
Regionwise, categorywise effort, catch and CPUE are presented in Table 6. Effort in this context is the estimated number of unit operations.

In the north east region, the effort of category II units increased by 35% but the catch and CPUE declined.

In the south east region the effort, catch and CPUE showed increase over 1993 in respect of categories I and II but in the category III though there was a decline of effort the catch showed slight increase of 1.3% and catch rate increased by about 8%.

In the south west region when compared to 1993, there was about 11% increase in effort in 1994 in respect of category I units but the catch declined by about 8% and the CPUE by about 17%. In respect of category II the effort was more or less the same but the catch and CPUE showed slight decline. In the case of category III units, the effort declined by about 19% and there was considerable decline in catch as well as CPUE.

In the north west region, the operations of category I units increased by about 9% and the catch as well as CPUE increased fairly over 1993. In respect of category III units there was reduction of effort by about 17% but the catch increased by about 20% and CPUE by 45%.



* Region-wise landings in different sectors during 1993 and 1994

Though, comparison of landings by different components within each category such as trawl net and purse-seine under category I and shoreseine and hook and line in category III may not be meaningful, CPUE is presented in order to have a general idea of each region with reference to different categories.

Evaluation of Change in the Pattern of Catch and Composition of Marine Fishery Resources in India (FSS/FRA/1.19)

K.S. Scariah, K. Alagaraja, K. Balan, T.V. Sathianandan and K. Vijayalekshmi

Reports on the changes in fishing pattern and resource composition of marine fisheries of Karnataka and Goa are under preparation. The report of Kerala is under publication.

* All the graphs included in this report are made by FRAD

Stock Assessment Techniques in Marine Fisheries Research and Management (FSS/FRA/1.3)

K. Alagaraja, K. Balan, K.S. Scariah, M. Srinath and T.V. Sathianandan

A model for simulating catch samples from a population, for given estimates of growth and mortality parameters of a species was finalised. A computer software for simulation of catch samples using this model was developed in FORTRAN. Parameters required for simulation of catch samples were estimated from past data on length frequencies and from publications for *Sardinella longiceps*. Using these parameters as inputs and with the help of the computer software developed, catch samples of 500 numbers each were sampled for 12 months from a total of 2,81,862 simulated samples.

Parameter estimates of *Sardinella longiceps* used for simulation:

Maximum life span : 4 years
Expected proportions of age groups:
below 1 year : 0.40, 1 to 2 years : 0.30
2 to 3 years : 0.20, 3 to 4 years : 0.05
above 4 years : 0.05

$L\alpha$: 221 ± 11 mm
K : 0.75 ± 0.04 per year
t_0 : -0.01 ± 0.001
Correlation between estimats of $L\alpha$ and K : -0.075
Number of major spawning seasons : One
Time distribution of spawning season : 0.578 ± 0.083 years
Recruitment size : 60 mm
Natural mortality : 0.80
Fishing mortality : 0.60
Minimum size retained by gears : 65 ± 10 mm
Maximum size retained by gears : 220 ± 10 mm

The simulated data were grouped into length frequency tables with different class widths of 5 mm, 10 mm and 15 mm. Using these data, $L\alpha$ and K were estimated using ELEFAN. The results obtained are tabulated below which indicate that 5 mm class width gives closer estimates of growth parameters compared to higher class widths.

Class width	Estimated $L\alpha$	Estimated K	Starting sample	Starting length	Rn
5 mm	228.0	0.70	11	135.0	0.325
10 mm	244.0	0.63	2	70.0	0.728
15 mm	263.0	0.52	4	157.5	0.719

Management Information Systems in Marine Fisheries (FSS/FRA/ST.1)

T.V. Sathianandan, K. Alagaraja, K. Balan, K.S. Scariah and K. Vijayalekshmi

Computer softwares in C language were developed for creation, updation and retrieval of country wise and world fish production, inland fish production in India and export information. Computer programmes for generation of random numbers, simulation of catch and stock samples were developed in FORTRAN. A Shell Script in UNIX was developed for the manipulation of QIC tape cartridge which is used for data backup.

The data base was updated with biological information like length, weight, sex, maturity stage etc., of samples collected at Vizhinjam, Tuticorin, Calicut, Mangalore and Bombay centres. During this period, 3762 Kilobytes of information was added to the data base in 539 data files. Verification of data in the created data base is in progress for oil sardine from these centres.

A data base was created for the world fish production and world production statistics for the years from 1974 to 1992 for 50 countries which are major contributors towards the world fish production was added to the data base. A data base for inland fish landings in the country was also created and state wise production of major groups of inland fishes were stored for the year 1990. Creation of a data base on export details is in progress.

Information regarding catch and effort of different species in different gears were provided to Scientists and Technical staff of the Institute for their research activities, and to other Research Organisations, State Departments and Industries.

Computer training was given to the staff at Mandapam, Tuticorin, Calicut and Mangalore Research Centres on MS DOS operating system, stock assessment packages, Data base management packages, catch estimation software and word processing. Technical help was extended to scientists in other divisions and to the staff in different sections for installation of softwares and for better use of their computer system.

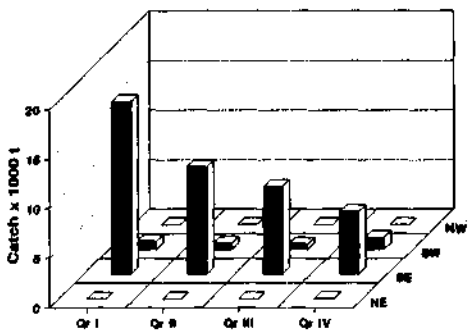
II. Pelagic Fisheries Division

The pelagic fisheries in the coastal waters of India exhibit wide seasonal and annual fluctuations. The exploitation level of some of the major resources had already reached the optimum level in the multigear fishery with varying target species. Considering these and the dynamic nature of the resources and the changing pattern of exploitation, the Pelagic Fisheries Division undertook 7 research projects during the year.

Fishery and Resource Characteristics of Sardines (*Sardinella* spp.) (PF/RE/1.1)

A.A. Jayaprakash, N.G.K. Pillai, K. Preetha, Prathibha Rohit and N.S. Radhakrishnan

During 1994-95, there was a decline in the catch of sardines along the west coast and increase along the east coast. The total sardine landing at four centres along the west coast was 2662 t as against 3589 t in 1993-94. An estimated 7208 t of sardines were landed at three centres along the east coast as against 2099 t in the same period of previous year.



Region-wise quarterly landings of Oil sardine during 1994

The landing of oil sardine which showed a decline in 1993-94 along the west coast continued the same trend in 1994-95 also. Purse seines and ring seines contributed the bulk of the sardine catch; they accounted for 93.8% and 3.3% respectively, followed by trawls (2.5%) and indigenous gears (0.2%) along the west coast and gill nets (27.3%) and trawl nets (72.6%) were the principal gears that contributed to the sardine landings along the east coast.

Sardinella gibbosa dominated (54.8%) along the west coast followed by *S. fimbriata* (28.2%), *S. albella* (9.7%) and *S. longiceps* (5.6%). *S. gibbosa* was dominant (54.4%) along the east coast also followed by *S. sirm* (14.8%), *S. albella* (14%), *S. longiceps* (9.2%), *S. dayi* (5.4%) and *S. fimbriata* (1.3%).

The overall size range of *S. longiceps* was 30-200 mm, with fishes of 60-165 mm length range dominating in the fishery. The size range of *S. gibbosa* was 90-185 mm, with size groups of 100-155 mm dominating the catches. *S. albella* occurred in the fishery in the size range 90-180, with 90-150 mm size groups dominating the fishery.

Mature and gravid specimens of *S. longiceps* were observed at Mangalore and Malpe during January and May respectively. Partially spawned specimens of *S. gibbosa* dominated the catch in this area from October to March. At Malpe, mature specimens of *S. fimbriata* occurred during September - October. At Tuticorin, spawning population of *S. gibbosa* was obtained during April - June, while immature fishes dominated the catch during July and August. *S. gibbosa* in the gravid stage was observed in all the months except in September and, November to January.

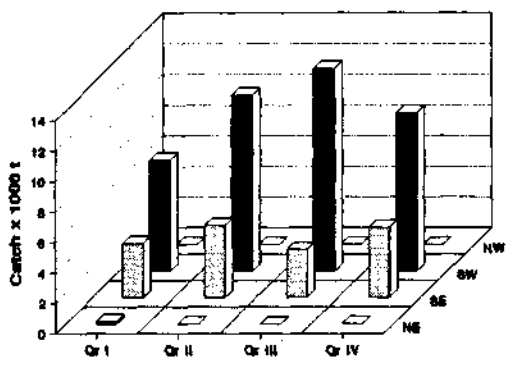
Recruitment of *S. longiceps* was reported at Visakhapatnam during June - August, when fishes of 30-100 mm were caught by boat seines, and that of *S. gibbosa* during January at Mangalore, July at Tuticorin and during September at Mandapam Camp. Young ones of *S. albella* were observed to be recruited to the fishery during August-October at Mandapam.

Fishery and Resource Characteristics of Anchovies (PF/RE/1.2)

N.S. Radhakrishnan, M. Zafar Khan, Prathibha Rohit, A.A. Jayaprakash, P.N. Radhakrishnan Nair and G. Gopakumar

Investigations were carried out at Bombay, Mangalore, Cochin and Vizhinjam. Anchovies were exploited by different gears like trawl, purse seine, boat seine, *dol* net, ring seine and *netholi vala*.

The total estimated anchovy landings from all centres was 5720 t realised by expending 1,15,853 mechanised and 54,138 non-mechanised unit operations. Trawls were the major gear landing 44.8% of total anchovy catch followed by purse seine (40.6%), boat seine (11.2%), *dol* net (2.1%), ring seine and *netholi vala* (0.6%). The landing was high at Mangalore (4792 t) and low at Bombay and Cochin (121 t & 130 t). Catch increased by 31% at Mangalore. 600% at Vizhinjam and declined by 78% at Cochin as compared to previous year. The peak fishing seasons for Anchovy were November-December at Mangalore, June-July at Vizhinjam and October and July at Cochin with highest CPUE of 563 kg for purse seine and 62 kg for trawl; 80-87 kg for boat seine, 20 kg for trawl and 101 kg for ring seine at Mangalore, Vizhinjam and Cochin respectively.



Region-wise quarterly landings of White bait during 1994

Stolephorus devisi was dominant at Mangalore (80%) and equally contributing as *S. bataviensis* at Cochin (44 & 43%). However, at Vizhinjam *S. buccaneeri* was dominant (74.2%). *S. buccaneeri* and *S. macrops* were caught in fair quantities by boat seine and ring seine at Vizhinjam and Cochin during the monsoon period contributing 62.5% and 5.7% respectively of these centres' catch. The other species supporting the fishery in a leaser magnitude are *S. macrops* and *S. buccaneeri* at Mangalore, *S. andhraensis* and *S. indicus* at Vizhinjam and *S. commersonii* and *S. buccaneeri* at Cochin. The overall species composition along the west coast was *S. devisi* (57%), *S. bataviensis* (30%), *S. buccaneeri* (9%) and other species.

The overall length ranges of anchovies caught by different gears are: *S. devisi* 30-100 mm, *S. bataviensis* 40-109 mm, *S. buccaneeri* 30-119 mm and *S. macrops* 40-75 mm.

In *Stolephorus bataviensis* at Mangalore, 23.1% were in developing, 11.2% in gravid and 54.2% in partially spawned conditions in trawl samples. With regard to *S. devisi*, 41.6% were in

developing, 7.6% in gravid and 36.2% in partially spawned condition in purse seine samples and 25.6% in developing, 9.5% in gravid, 57.9% partially spawned and 5.6% spent condition in trawl samples. At Vizhinjam, the data showed that the percentage composition of resting, developing and partially spawned specimens of *S. devisi* were 27%, 17% and 52%, of *S. bataviensis* 90%, 10% and 0% and of *S. buccaneeri* 7%, 0% and 83% respectively. At Cochin, *S. bataviensis* with developing gonads was observed during November-December and during February for *S. devisi*. Spent fishes of both the species were found during February. In ring seine catch, 72% of *S. macrops* were in spent condition.

At Bombay 121 t of Golden achovy (*Coilia dussumieri*) was landed by expending 6105 effort units which formed 5% of the *dol* net catch. The CPUE was 19.9 kg. Size range was 20-199 mm. CPUE increased from 11.8 to 34.6 kg from October to December. Highest CPUE (48.8 kg) was during April. Male: Female ratio was 1:0.6. 98% of the females were either in resting or developing stage. 2% gravid females were observed during March. The total mortality coefficient (Z) estimated was 5.7 with F/Z = 0.47.

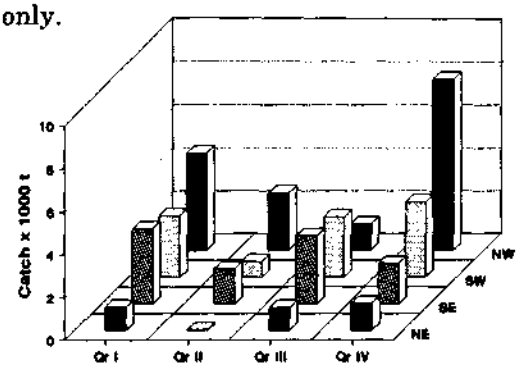
Fishery and Resource Characteristics of Seerfishes (PF/RE/2.1)

C. Muthiah, K.P. Said Koya, Alexander Kurien, N.G.K. Pillai and H. Mohammed Kasim

Work was carried out at seven centres, 5 on the west coast (Veraval, Bombay, Mangalore, Calicut and Cochin) and 2 on the east coast (Tuticorin and Madras). Seerfishes were exploited by several gears like gill net, trawl, hooks and lines and purse seine at different centres.

The total seerfish catch at the seven centres was 3670 t as compared to 4084 t in the last year showing 10% reduction in production. Gillnet was the major gear as in last year contributing 57.38% of seerfish catch followed by trawl 36.16%, hook and line 5.8%, purse seine 0.59% and indigenous gears 0.06%. The production was highest at Veraval (799 t) and lowest at Bombay (78.5 t). The peak fishing season was January at Veraval and Bombay, October at Mangalore/Malpe, September at Calicut, August at Cochin and July at Tuticorin and Madras. The C/E varied from 9.74 kg at Bombay to 185 kg at Madras in gill net and from 1.22 kg at Cochin to 19 kg at Mangalore/Malpe in trawl.

The king seer *Scomberomorus commerson* and the spotted seer *S. guttatus* contributed to the landings each forming 67% and 33% respectively. The other two species viz., the 'streaked seer' *S. lineolatus* and the 'wahoo' *Acanthocybium solandri* were caught in small quantities at Tuticorin only.



Region-wise quarterly landings of Seerfish during 1994

The size distribution analysis showed that *S. commerson* was exploited at larger lengths by gill net (36-106 cm) and hook and line (60-112 cm) and at smaller lengths

by trawl (20-68 cm) and purse seine (28-36 cm). For *S. guttatus* both gill net and trawl exploit fishes of more or less the same lengths (18-54 cm).

The youngfish component in the commercial fishery was negligible (0-2.5%) in the large-meshed gill net at all centres, but in the small meshed gill net (*'podivalai'*) at Tuticorin, it formed 64% of the total estimated numbers of fish. In the case of trawl, young fish formed 55% at Mangalore/Malpe, 34% at Cochin and 67% at Tuticorin.

Studies on the mortality rates and exploitation ratios of the dominant species *S. commerson* exploited by different gears at Tuticorin and Mangalore/Malpe have shown that this species is subjected to heavy exploitation at these centres (E = 0.50 in *paruvalai*, 0.89 in *podivalai*, 0.83 in trawl and 0.76 in hook and line at Tuticorin; 0.60 in gill net and 0.84 in trawl at Mangalore/Malpe). As in the previous years, young fish below 34 cm were caught abundantly by *podivalai* (64%) and trawl (67%) at Tuticorin and by trawl (55%) at Mangalore/Malpe causing concern as it may lead to recruitment overfishing.

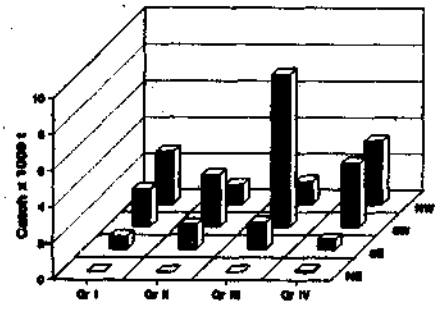
Fishery and Resource Characteristics of Tunas, Tuna Livebaits and Billfishes (PF/RE/2.2)

P.P. Pillai, K.P. Said Koya, M. Zafar Khan, C. Muthiah, N.G.K. Pillai, G. Gopakumar, H. Mohammad Kasim, M. Sivadas and A.K.V. Nasser

Investigations were carried out at nine centres, six on the west coast (Veraval, Bombay, Mangalore, Calicut, Cochin and Vizhinjam) 2 on the east coast (Tuticorin and Madras) and one in Lakshadweep (Minicoy).

Tunas were mainly exploited by gill nets at all the centres, and also by purse seines at Mangalore-Malpe and Cochin; by hooks and line at Vizhinjam and Tuticorin and by pole and line and troll lines at Minicoy. The total catch of tunas at these centres collectively was 8999 t, which recorded an increase of 1555 t (20.9%) as compared to last year. Mangalore recorded maximum increase (375%) followed by Calicut (32.9%), Madras (300%), Vizhinjam (40%) and Minicoy (19%) when compared to the previous year. Centres which showed decline in the catch were Veraval (33.3%), Cochin (26.5%), Bombay (19.2%) and Tuticorin (5.2%).

Gillnet contributed 49.2% of total tuna catch followed by hooks and lines (21.9%), purse seines (16.5%), pole and line (12.2%) and troll lines (0.2%).



Region-wise quarterly landings of Tunas during 1994

A marginal increase of 10.8% in the effort of gillnet was noted at Calicut, but at all the other centres the effort expended declined as compared to the previous year. In the purse seine fishery, decrease in effort was noticed both at Mangalore (76%) and Cochin (19%) but C/E showed an increase at both the Centres. Hook and line fishery showed an increase in effort both at Vizhinjam (34%) and Tuticorin (29%). At Minicoy, pole and line fishery

showed an increase in effort (10.9%) but there was only a marginal increase in CPUE.

The CPUE varied from 16.5 kg at Mangalore to 113 kg at Madras in the gillnet and in the purse seine fishery, the range was 5.1 kg at Cochin to 6.5 kg at Mangalore. In the hook and line, the CPUE was relatively high in the mechanised units (26.3 kg) at Vizhinjam and it was about 1.9 kg at Tuticorin. At Minicoy, the CPUE in the pole and line fishery was 305 kg and that in the troll line fishery 74 kg.

The peak fishing season for tuna was September-October at Bombay and Veraval; August to November at Mangalore; May to September at Calicut and Cochin; June-July and November-December at Vizhinjam; June-August at Tuticorin and Madras. The tuna fishery at Minicoy (Lakshadweep) did not show a clear pattern, but exceptionally good landings were observed in October.

The overall species composition of tunas from all centres was as below:

Species	%
Euthynnus affinis	30.0
Auxis thazard	23.2
A. rochei	19.8
Katsuwonus pelamis	11.1
Thunnus tonggol	6.6
T. albacares	4.7
Sarda orientalis	4.7

Species composition of tunas taken by different gears is given below:

The size range of *E. affinis* in the catch was 20-76 cm and that of *A. thazard* was 26-50 cm. Smaller specimens (14 cm) of *A. thazard* were observed only at Cochin. The size range of *T. tonggol* was 30-98 cm with dominant size range at 46-68 cm. However, large specimens (40-98 cm) supported the fishery at Veraval. *T. albacares* occurred in the size range of 60-114 cm with the dominant group at 68-88 cm along the mainland and 26-72 cm in the pole and line fishery at Minicoy with dominant size groups of 46 and 60 cm. The size range of *A. rochei* was 18-36 cm and the fishey supporting group was 24-28 cm. *K. pelamis* ranged from 26 to 72 cm in the pole and line fishery at Minicoy with dominant size group at 36-48 cm. *S. orientalis* which was found only at Vizhinjam had a size range of 18-54 cm in the catch.

At Veraval, females dominated the catch (54.4%) of *T. tonggol* in the gillnets. Fishes with ovaries in advanced stage were observed in the fishery from May onwards and spent fishes from September onwards, indicating the spawning period. Majority of the fishes examined had empty stomachs and the food items present in the guts were also partially digested. 49% of the fishes had fish and squid remains in their stomachs. Feeding intensity was maximum during January-March.

At Minicoy, an overall dominance of males was observed in *K. pelamis*. The dominant feeding condition was half full stomachs. Gut content was invariably the bait fish used and in most cases it was intact. The only natural food that was encountered in most of the months was squid and that too was intact. Only in March, besides bait fishes, *Canthigaster* sp.and the pelagic crab *Charybdis callianassa* were seen in the stomachs.

Based on the growth parameters estimated using the earlier years' data, the mortality and the exploitation rates of *E. affinis* landed by drift gill nets at Mangalore were computed as Z = 0.87, F = 0.16,

Gears	*E. affinis*	*A. thazard*	*A. rochei*	*T. tonggol*	*T. albacares*	*K. pelamis*
Drift gillnet	46%	32%	8%	8%	6%	-
Purse seine	42%	45%	13%	-	-	-
Hook and line	40%	20%	38%	-	2%	-
Pole and line	-	-	-	-	9%	91%
Troll line	-	-	-	-	67%	33%

M = 0.71 and E = 0.18. The length at capture was 30 cm and the corresponding age is about one year. From the population parameters, it is seen that the present level of exploitation is far below the optimum and that there is scope to increase the gill net effort further for enhancing the production of this species from Mangalore-Malpe area. However population studies at Tuticorin indicated that *E. affinis* and *A. thazard* are being exposed to higher fishing pressure. Either a reduction in the effort input or an increase in mesh size of *paruvalai* is needed at this centre to maintain optimum exploitation rate. Various population parameters computed are given below:

The annual bait fish catch was 14 t at Minicoy, with a CPUE of 4 kg. Apogonids contributed 35% of the total catch followed by clupeoids (33%) and caesionids (31%). Mean standard length of baitfishes ranged from 14.6 to 78.6 mm and mean total weight from 0.7 to 9.7 kg. At Agatti, the total baitfish catch was about 45 t with a CPUE of 13 kg. The estimated exploitation of baitfishes from Lakshadweep was about 100 t. The major fishing areas for *S. delicatulus* were Perumal Par (Agatti) and Bangaram. Copepods, fish eggs, decapod larvae and fish remains formed the major food items. *S. delicatulus* seems to have a protracted spawning period with a peak in November-December.

Billfishes formed only 0.5% of the total gillnet landings at Veraval. March was the most productive month and the catch realised was 10.7 t at 3.9 kg/unit. There was no billfish landing during

Species	Sex	$L\alpha$ mm	K	t_o	Fishing mortality rate	Exploitation rate
E. affinis	Male	798	0.7401	0.0224	1.14	0.56
	Female	822	0.8017	0.0109	1.23	0.72
A. thazard	Male	603	1.2268	0.0021	1.88	0.87
	Female	630	0.9664	0.0012	1.49	0.72

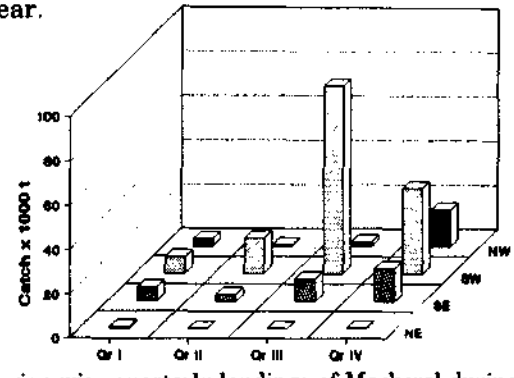
May - October. At Bombay *Xiphias gladius* formed 16.6% (31.7 t) of the gillnet landings. Two species of billfishes (*Istiophorus platypterus* and *Makaira indica*) constituted less than 1% of gillnet fishery at Mangalore. Similarly billfishes formed about 1.6% of gill net fishery at Cochin. Billfish landing at Vizhinjam was estimated as 20.4 t. Major portion of the catch was by hook and line (62%). Motorised crafts landed about 95% of the catch. Landings were almost entirely of *Istiophorous platypterus*. At Tuticorin, about 40.6 t of bill fishes were landed by *paruvalai* and 2.6 t by hook and line units. *I. platypterus* (90%) and *M. indica* (10%) constituted the *paruvalai* landings and *I. platypterus* the hooks and line landings.

Fishery and Resource Characteristics of Mackerel (PF/RE/2.3)

G. Gopakumar, K. Preetha, Prathibha Rohit, P.P. Pillai, P.N. Radhakrishnan Nair, H. Mohammad Kasim and G. Luther

Investigations at Karwar, Mangalore, Calicut, Cochin, Vizhinjam, Tuticorin, Mandapam and Visakhapatnam showed that the mackerel was mainly exploited by the purse seines, trawlnets, ring seines, gillnets and artisanal gears along the west coast. On the east coast gillnets and trawlers were the major gears. The catch showed a decrease at Karwar, Mangalore, Tuticorin and Mandapam compared to last year. The purse seines were operated at Karwar, Mangalore and Cochin. At Karwar, the purse seine catch (490 t) decreased by 86% and C/E (44 kg) by 65%. Similar trend was seen at Mangalore where the catch (7565 t) declined by 25% and C/E (563 kg) by 19%. At Cochin, though the purse seine effort input (2104) decreased by 22% the catch (4192 t) doubled and C/E (1969 kg) increased by 92%.

The trawl catch (1969 kg) and C/E (18 kg) at Mangalore registered 119% and 129% increase respectively over last year. At Cochin, the trawl effort (34654), catch (239 t) and C/E (7 kg) declined by 17%, 54% and 40% respectively. The same trend of decrease in the catch (125 t) and C/E (3.7 kg) to the tune of 17% and 20% was seen at Tuticorin also. At Pamban, with an effort (9770) increase of 21%, nearly 81% increase in catch (175 t) was recorded. The pair trawlers at Pamban and Rameswaram landed 461 t (C/E 362 kg) and 223 t (43 kg) respectively. The trawl catch (110 t, C/E 7 kg) of mackerel at Visakhapatnam registered a three fold increase over last year.



Region-wise quarterly landings of Mackerel during 1994

The ring seine was the major gear at Calicut, which exploited 359 t at a C/E of 483 kg registering an increase of 60% and 260% respectively. The catch by the same gear at Cochin was 808 t at a C/E of 213 kg. At Vizhinjam, motorised drift gillnets and hooks and lines were the major gears, which landed 410 t (C/E 7.4 kg) and 368 t (5.3 kg) respectively. Night fishing during January by hooks and lines using light attraction devices has yielded a higher C/E (18 kg). The catch (35 t) by

Podivala (gillnet) at Tuticorin was low, but realised a higher C/E of 9 kg inspite of a reduction in effort (3885) by 60%.

While young as well as adult mackerel of 55-270 mm length with multimodal distribution were encountered in the trawlers, ring seines, hooks and lines, *paruvalai* and boat seine, the gillnets exploited large-sized specimens of 140-265 mm length. In the purse seine, the size range was 165-265 mm at Cochin and 70-270 mm at Mangalore.

Males dominated the catch at Karwar, Mangalore and Cochin, whereas at Vizhinjam and east coast centres, females dominated. Gravid and spent fishes were noticed in all the gears at Mangalore and spawning started by October and continued till March. Spawning activity was noticed during January-March at Cochin; January-April and August-September at Vizhinjam; October and March at Mandapam and from August to March at Visakhapatnam.

Recruitment to the fishery was observed on the east coast centres during April - July. On the west coast it was from February to September at the different centres.

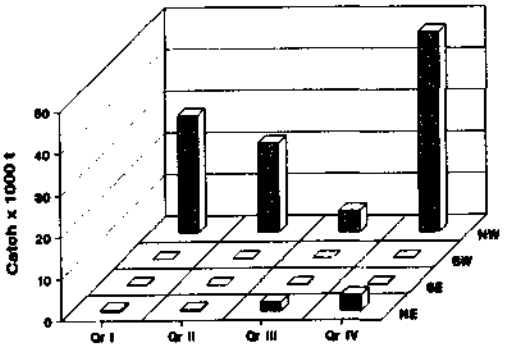
The exploitation of the preadults was at its maximum by the trawlers and the ring seines at Cochin; 99% of the boat seine catch at Vizhinjam consisted of preadults; at Calicut 43% of the catch by ring seines consisted of preadults. At other centres, preadults constituted 7-23% of the catch.

At Tuticorin, the growth parameters were estimated as $L\alpha$ = 331.5 mm, K = 1.106 and t_0 = 0.0005. Natural mortality rate was estimated as 1.86, total mortality rate as 8.2 by *Podivala* and 13.4 by trawlnet. Fishing mortality rate was at 6.34 by *Podivala* and 11.54 by trawlnet. The exploitation rate was 0.77 by *Podivala* and 0.86 by trawlnet.

Fishery and Resource Characteristics of Bombay-Duck (PF/RE/3)

Alexander Kurien and K.P. Said Koya

At Bombay, Bombay duck landing was 1796 t registering a growth of 82.5% over the previous year. Along the Saurashtra coast of Gujarat the catch was 47,255 t registering an increase of 85.1% over the previous year. Bombay duck represented 61.8% and 59.2% of the total *dol* net landings in Maharashtra and Gujarat respectively. Total effort by *dol* net increased in both the states, and the total effort expended was 10490 and 83693 units respectively in Maharashtra and Gujarat. CPUE of *dol* net in Gujarat was highest being 565 kg compared to that of Maharashtra (171.2 kg). Peak landings were recorded during May in Maharashtra (384.7t) and in November in Gujarat (10287 t); the lean period was in July in both the states.



Region-wise quarterly landings of Bombay duck during 1994

The fishery was supported by fishes of 30-300 mm , with modes at 105, 165 and 195 mm in Maharashtra and by 15-395 mm with modes at 45,60,120 and 225 mm in Gujarat; in Gujarat, 157 t of the Bombay

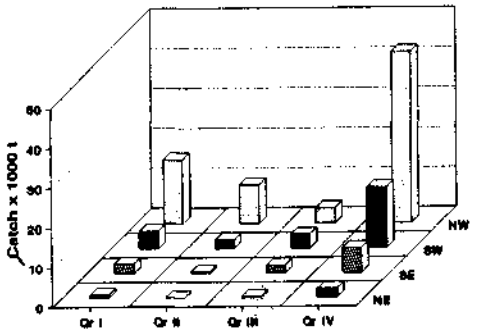
duck landed was represented by juveniles of less than 74 mm size.

In Maharashtra the males (54.1%) were dominant in the catch whereas in Gujarat (54.3%) females were dominant. Females with developing and gravid ovaries were observed throughout the year in both the states and spent specimens during August and January-March period in Maharashtra and during May, July and December in Gujarat. Along the Gujarat coast, two peak spawning periods were observed: a pre-monsoon phase and a winter phase. Bombay duck being a carnivorous fish, the principal food items were fishes, crustaceans and molluscs.

Fishery and Resource Characteristics of Ribbonfishes (PF/RE/4)

P.N. Radhakrishnan Nair, K.K. Joshi, M. Zafar Khan, K. Preetha, C. Muthiah and S. Lazarus

Ribbonfishes formed a major fishery almost throughout the year at Veraval, Bombay and Mangalore on the west coast and at Madras and Visakhapatnam on the east coast. Along the south Kerala coast, they formed a seasonal fishery during the monsoon and post-monsoon period. At Madras, the ribbonfish was taken using only trawl net and the total landing was 1827 tonnes, whereas at Visakhapatnam both trawl and boat seine exploited these fishes and the estimated catches were 185.5 t and 29.3 t respectively.



Region-wise quarterly landings of Ribbon fish during 1994

Along the west coast, in most of the centres ribbonfish was exploited mainly by trawl net, except at Vizhinjam where, only traditional gears like boat seine, gill net and hooks and line exploited this resource. In addition to trawl, these fishes were caught in gill nets at Veraval and Madhwad; in purse seine at Mangalore and Cochin and in shore seine at Karwar.

The operations of trawl units at all these centres showed a substantial increase during the year when compared to the previous year; the increase was 10402 unit operations which accounted for 27.1% increase. Increase in the catch, however, was only 865.7 t (4.7%). The catch in trawl at different centres ranged from 20 t at Karwar to 2893 tonnes at Mangalore and the C/E was maximum (194 kg) at Bombay and minimum (1.1 kg) at Karwar. The gill nets contributed 104 tonnes at Veraval, 247.4 tonnes at Madhwad and 3.6 tonnes at Vizhinjam with the C/E at 3.3 kg, 10.8 kg and 0.1 kg respectively. The purse seine landings were 158.2 tonnes at Mangalore and 6.3 tonnes at Cochin with C/E of 11.8 kg and 3 kg respectively. At Vizhinjam, boat seine contributed 76% (67.3 tonnes) of the total catch (88.4 tonnes) while in other gears the catches were 3.6 tonnes (4%) in drift gill net and 17.5 tonnes (19.8%) in hooks and line. The C/E in boat seine was 5.7 kg while in the other two gears it was less than 1 kg.

In most of the centres the fishery season for ribbonfish was the postmonsoon period, but in some centres there was a peak in the pre-monsoon period also. On

the west coast, the major seasons were April-May and September-January at Veraval and Bombay; January-May at Karwar; April-May and September-November at Cochin and July-August at Vizhinjam. Along the east coast it was a post-monsoon fishery extending from October to February at Madras and August to December at Visakhapatnam.

Trichiurus lepturus constituted the bulk of the fishery at all the centres. Species such as *T. russelli, Lepturacanthus savala, L. gangeticus* and *Eupleurogrammus muticus* together constituting to 4.2% in trawl were also reported from Visakhapatnam.

The size of *T. lepturus* ranged from 20 to 115 cm in trawl, 30 to 102 cm in gillnet and from 13 to 84 cm in boat seine. In trawl, 20 cm size fish was reported from Veraval, Cochin and Madras. A multimodal length distribution with the modes ranging from 24 cm (at Cochin) to 110 cm (at Malpe) was noticed in most of the centres except Bombay where a single mode at 75 cm was reported. In gill net at Veraval and Madhwad the size range was 31-102 cm with modes ranging from 34 cm to 92 cm. In the boat seine catch at Visakhapatnam the length range was 13 - 84 cm with modes ranging from 24 to 75 cm.

The recruitment size in trawl net was 20-22 cm in most of the centres except at Bomby (40 cm) and Mangalore (32 cm). In gillnet it was 30 cm at Madhwad and 34 cm at Veraval. The smallest size of recruitment was 13 cm reported from boat seine at Visakhapatnam. The periods of recruitment were April, May and October at Veraval, April, June, November and January at Bombay; May and August at Cochin and June to September at Visakhapatnam.

The sex-ratio (M:F) among the pre-adults reported from the trawl catches at Mangalore, Malpe and Visakhapatnam was 53.7 : 46.3, 57.5 : 42.5 and 36 : 64 respectively. Among the adults, females dominated at Veraval (56.6%), Mangalore (55.9%), Malpe (55.5%) and Cochin (55.8%) and the males dominated at Bombay (50.7%) and Visakhapatnam (53%). In gill net at Veraval, females dominated forming 53.3%. Spawning season was generally November to May or June. The percentage of gravid and spent fishes was more at Mangalore-Malpe region and also at Veraval and Bombay regions.

Stock assessment studies were conducted in *T. lepturus* at Mangalore using trawl data. Using the growth parameters estimated earlier, the mortality parameters were calculated as Z = 1.89, F = 1.16 and M = 0.73. Using these parameters, the exploitation ratio was estimated as 0.61, the total stock as 5,563 t; the standing stock as 2,494 t and the MSY as 2,357 t. Since the current production of 2,893 t is higher than the MSY, there is need to bring down the effort from the present level.

III. Demersal Fisheries Division

During 1994, the estimated demersal finfish catch was about 6,75,000 t which showed an increase of 7.4% over 1993. Most of this catch was taken by mechanised vessels. Croakers were the most dominant group of fish which formed 29% of the total demersal finfish catch, followed by thread-fin breams (12%), silverbellies (10.4%), perches (groupers, snappers, pigface breams) (9.6%), elasmobranchs (8.6%), catfish (6.7%), flatfish (6.6%) and others.

The trawlers at different centres conducted fishing at distances upto 90 km from the shore at depths of 7-120 m. The maximum distance and depth were off Veraval. The cod end mesh size of trawl net was very small and was 10-15 mm at Visakhapatnam and Madras.

Frequent clashes between mechanised and motorised vessel operations were reported from Veraval, which resulted in the decline of catch and increase in prices of fish.

Work on resource characteristics of important components of demersal finfish was carried out from different centres and the results are presented below:

Monitoring the Resource Characteristics of Elasmobranchs (DF/RE/1)

P. Devadoss, S. Lazarus, S.G. Raje, Grace Mathew, R. Marichamy and V. Gandhi

This project was carried out at Bombay, Cochin, Tuticorin, Mandapam and Madras. The total catch from all these centres by small trawlers, drift gill nets, bottom set nets, long lines, hooks and lines and medium sized boats operating deep sea trawl was estimated at 6970.5 tonnes. While trawlers operated at all these centres, drift gill netters were operated at Madras, and bottom set nets and deep sea trawlers at Tuticorin. Landings at Bombay constituted 45.5% of the total of all these centres followed by Tuticorin (23%), Madras (16.5%), Mandapam (12.8%) and Cochin (2.2%).

The catch rate at Bombay was 109 kg in trawl. There was a decrease of 10% in the catches over last year. The catch consisted of sharks (72%), rays (18%) and guitar fishes (10%). *Scoliodon laticaudus*, *Rhynchobatus djiddensis* and *Dasyatis zugei* were dominant among sharks, guitar fishes and rays respectively. In *S. laticaudus*, the length range was 16-58 cm with the mean at 39.5 cm for males and 14-62 cm with the mean at 41 cm for females. Male : female ratio in the catches was 1:1.2. Fourteen pregnant specimens were recorded and upto a maximum of 6 embryos were obtained from a single female. This shark was observed to feed on ribbon fishes, Bombay duck, *Coilia dussumieri*, sciaenids, *Solenocera*, other prawns and cephalopods.

A total of 1,603 t of elasmobranchs were landed at Tuticorin, the contribution from trawlers being the highest with 88%, drift gill nets contributing 181 t, bottom set nets 102 t and deep sea trawlers 72 t. There was an increase of 75% in the catch over that of previous year. Sharks formed 100% of elasmobranch catch from deep sea trawlers and 98% of this was constituted by the bramble shark, *Echinorhinus brucus*. Rays formed 79% of elasmobranchs in shrimp trawls and 99.5% in bottom set nets.

At Mandapam an estimated 892 t were landed by trawlers at a catch rate of 12 kg per boat.

The total production at Cochin was estimated at 155 t from trawl, drift gill net, hooks and line and long lines as against 228 t of last year. *Rhizoprionodon acutus* was the dominant species in both drift gill nets and hooks and lines while *Dasyatis* was so in the trawl. *Carcharhinus melanoptera* ranged in size between 55 and 95 cm.

At Madras, in spite of increased effort of 21%, a reduction of about 9% over the previous year was observed in the landings of this year. Trawlers contributed about 97% of the total of 1114 t. Rays formed the major components of elasmobranchs (85.4%), distantly followed by sharks (8.8%) and guitar fishes (5.9%). *Dasyatis* spp. formed 69% followed by *Rhinoptera javanica* (17%) and the remaining by the other groups. *R. javanica* and *D. jenkinsii* ranged between 35 and 164 cm with the mean at 97.8 cm; and between 35 and 104 cm with the mean at 66.2 cm respectively.

Monitoring the Resource Characteristics of Major Perches (Epinephelids, Lutjanids, Lethrinids) (DF/RE/2)

S. Lazarus, S.K. Chakraborty, Grace Mathew and K.K. Philipose

The fishery of major perches showed a slight decline over the previous year. Trawlers were the main gear operated at Bombay; trawlers, hooks and lines as well as gillnets at Madras and hooks and lines at Vizhinjam and Cochin. At Cochin and Vizhinjam, the peak season was from December to March, while the same was May-October at Tuticorin. At Madras the maximum landings were during July-October months.

Epinephelus diacanthus and *E. tauvina* were dominant at Bombay, *E. diacanthus, E. bleekeri, E. chlorostigma, E. albomarginatus* and *Pristipomoides typus* at Cochin, *Lethrinus nebulosus, L. lentjan, Lutjanus* spp. and *Serranus* spp. at Vizhinjam, *Lethrinus nebulosus* and *Lutjanus rivulatus* at Tuticorin and *E. tauvina, Lutjanus johni* and *L. malabaricus* at Madras.

At Cochin *E. diacanthus, P. typus, E. chlorostigma* were mostly in indeterminate stage or preadult stage. *E. diacanthus* ranged from 26 to 56 cm with mode at 35 cm, *P. typus* from 26 to 83 cm with dominant mode at 45 cm, *E. chlorostigma* from 28 to 75 cm with the mode at 65 cm. In *E. tauvina* 75 cm was the dominant modal value. Majority of these species were in stages II and III during December-March.

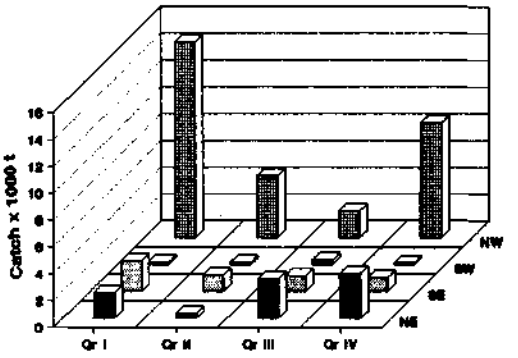
At Vizhinjam, *L. nebulosus* ranged from 20 to 56 cm with the modes at 39 cm. Most of the fishes during December were in spent condition. *L. lentjan* was in maturity stage III. At Tuticorin *L. nebulosus* ranged from 10 to 74 cm, with modes at 18 and 56 cm.

At Madras *E. tauvina* was in the length range of 25-95 cm with modes at 35, 55 and 70 cm. Maturity stages I and II occurred throughout the year. In *L. johni*, the length range was 19-84 cm with modes at 30 and 70 cm. Maturity stages I and II predominated in this species also.

MONITORING THE RESOURCE CHARACTERISTICS OF CAT FISHES (DF/RE/3)

N.G. Menon, S.G. Raje and P. Nammalwar

Data were collected from four centres, two along the west coast and two along the east coast. The landings showed decline at all centres except at Bombay where, the landing was the same as in the previous year. At Bombay the trawlers landed 2,100 t with a catch rate of 72 kg. Of the six species; *Osteogeneiosus militaris, Tachysurus dussumieri, T. coelatus, T. thalassinus, T. sona, T. tenuispinis* the first two were dominant, each forming 29% of total catfish catch. Females of *O. militaris* and (11.7t) and drift net (14 t) showed a steep decline and only one species *T. thalassinus* formed the fishery. Hooks and lines landed an estimated quantity of 33 t of *T. dussumieri* in the size class 15-80 cm at Madras. The annual



Region-wise quarterly landings of Cat fish during 1994

landing by trawlers at Visakhapatnam was 29 t at a catch rate of 0.8 kg/unit effort showing a decline of 18% compared to 1993-94. The catch consisted of *T. thalassinus* (95%) in the size range 12-40 cm.

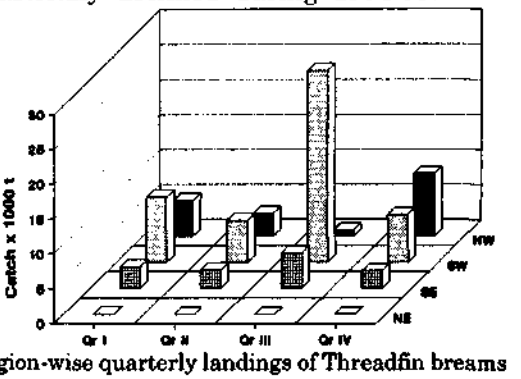
MONITORING THE THREADFIN BREAMS AND SILVER BELLIES (DF/RE/4)

E. Vivekanandan, P.P. Manoj Kumar, S.K. Chakraborty, P. Livingston, P.U. Zacharia, N.G. Menon, V.S. Rengaswamy, V. Gandhi, A. Raju and K.M.S.A. Hamsa

The project on stock assessment of threadfin breams and silverbellies was implemented at 10 centres and data from 14 major fishing harbours were collected. Both the resources are almost exclusively exploited by trawlers.

Threadfin breams

During 1994-95, maximum threadfin bream landings (6000 t) were obtained at Cochin followed by Madras (5,942 t), Bombay (3,421 t), Mangalore (2,870 t), Tuticorin (2,227 t) and Veraval (1,345 t). Compared to last year, the landings were substantially higher in most of the centres; Veraval and Mangrol were the only centres where there was a decline in the catch. There is a decline in threadfin bream as well as total trawl catch in Veraval during the past few years; the CPUE also drastically declined during 1994-95.



Region-wise quarterly landings of Threadfin breams during 1994

The CPUE was the highest in Madras (109.0 kg) and Bombay (108.8 kg).

Compared to 1993-94, the CPUE was higher in all the centres except in Veraval.

Totally 6 species of threadfin breams were recorded. *Nemipterus japonicus* dominated the catch in Veraval, Mangrol, Mangalore, Malpe and Kakinada; *N. mesoprion* at Bombay and Visakhapatnam; *N. delagoae* in Tuticorin and *N. peroni* in Rameswaram and Pamban. In Madras, *N. japonicus*, *N. mesoprion* and *N. delagoae* formed almost equal percentage.

The length range of *N. japonicus* in these centres was 40 (Kakinada) - 319 (Veraval) mm. Juveniles measuring less than 100 mm were recorded in almost all the centres. The mean length was less than the length at first maturity in Bombay and Madras. In all the centres, females in all the stages of maturity were recorded; females with ripe gonads were abundant in the catch during April-September in Mangalore; during October-December in Veraval, Madras and Kakinada. In all the centres, crustaceans and fish were the major food of *N. japonicus*.

The length range of *N. mesoprion* was 30 (Kakinada) - 269 (Bombay) mm. The modal length was very small in Madras (120-129 mm) and Kakinada (75-79 mm). Similar to *N. japonicus*, the major food of *N. mesoprion* were crustaceans and fish.

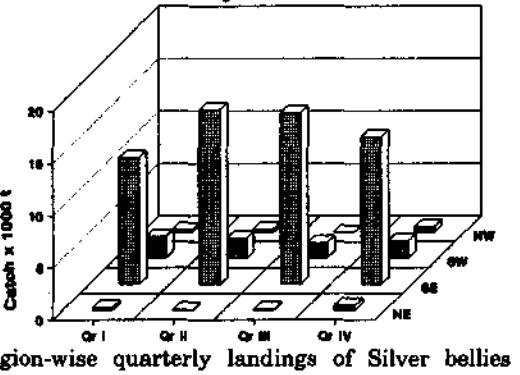
At Mangalore, the different parameters were estimated for *N. japonicus* as: $L\alpha$ = 317 mm; K = 0.84/yr; to = 0.04 yr; Z = 4.54. At Bombay the different estimates are:

Species	Z	M	F	E	U	Y (t)	Y/U (t)	Y/F (t)
N. japonicus	3.94	1.55	2.39	0.60	0.59	1245	2100	521
N. mesoprion	2.81	1.57	1.24	0.44	0.41	2025	5012	1657

Silverbellies

During 1994-95, the maximum silverbelly landing was in Rameswaram (16,365 t), followed by Madras (7,264 t), Pamban (3,572 t), Tuticorin (2,925 t) and Mandapam (2,648 t). Compared to 1993-94, the catch was higher in all the centres except in Veraval, Mangrol and Visakhapatnam. The CPUE was the highest in Pamban (395.3 kg) followed by Rameswaram and Madras.

Of the 16 species landed, *Leiognathus bindus* and *Secutor insidiator* were recorded in all the centres. *L. bindus* dominated the fishery in Madras, Kakinada and Visakhapatnam; *S. insidiator* in Mangalore and Malpe; *Gazza minuta* in Karwar, Tadri and Tuticorin; *L. dussumieri* in Pamban and Tuticorin and *L. jonesi* in Rameswaram.



Region-wise quarterly landings of Silver bellies during 1994

The length range of *L. bindus* was 20-124 mm at Madras. Juveniles of

55-59 mm formed the modal length group in Kakinada. The length range of *S. insidiator* was 30 mm (Kakinada) - 154 mm (Malpe), Females in all stages of gonadal development were recorded in all centres. In Malpe and Kakinada, females with ripe gonads were abundant in the catch during October-December.

Stock Assessment of Croakers (DF/RE/5)

S.K. Chakraborty, P.P. Manojkumar, P. Livingston, M. Feroz Khan, S. Sivakami, V.S. Rengaswamy, V. Gandhi, P. Devadoss, A. Raju and K.M.S.A. Hamsa

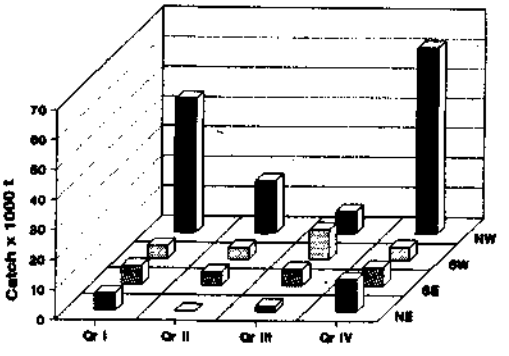
The highest catch of 9,354 t was recorded at Veraval followed by 6,945 t at Bombay and other centres. A decline in the catch was recorded at Veraval, Kakinada, Visakhapatnam, Calicut and Cochin whereas Bombay and Madras recorded an increase. Except Veraval where the depth of operation went up from 70 to 120 m, there was no change in the depth, area and mesh size of the gears. Majority of the catch was from trawl nets. At Veraval and Tuticorin the majority was landed by *dol* and gill nets respectively.

Biological study was made on *J. glaucus* and *O. cuvieri* from Veraval, *J. sina* and *P. macropthalmus* from Bombay, *J. carutta* from Visakhapatnam, *N. maculata* from Kakinada, *O. ruber* and *J. maculatus* from Tuticorin and *P. macrophthalmus*, *N. maculata* from Mandapam and *J. sina* and *O. ruber* at Cochin.

Mortality and stock parameters were assessed for four species from Bombay.

Eleven species were recorded at Madras, of which *O. ruber* contributed to 49% of the catch and *K. axillaris* to 13%. Size of the former species ranged from 10 to 25 cm and that of the latter from 10 to 18 cm. The Male : Female ratio was 1:1:5 in *O. ruber* and 1:1:3 in *K. axillaris*. Mature *O. ruber* occurred in October-February and *K. axillaris* during January-March.

The total catch at Calicut was marginally higher than last year's catch, made exclusively by trawlers and CPUE of 15.12 kg was recorded. *J. sina* and *O. ruber* were the dominant species. The length range of *J. sina* was 10-16 cm and that of *O. ruber*, 14 to 19 cm. The mean length recorded was 13.3 cm for *J. sina* and 15.7 cm for *O. ruber*. While the former species has shown an increase in mean size, the latter has shown a decline. Females predominated males and all the females were in maturing condition.

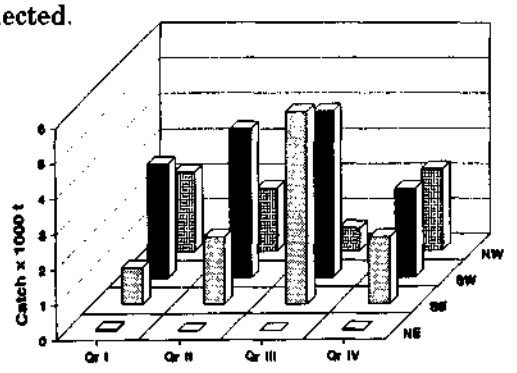


Region-wise quarterly landings of Croakers during 1994

Biology and Resources Characteristics of Lizard Fishes, Polynemids and Flat Heads (DF/RE/6)

S. Sivakami, P.P. Manoj Kumar, S.G. Raje, M. Feroz Khan and E. Vivekanandan

Data at 5 centres: Bombay, Veraval (Mangrol and Dhamlaj also), Cochin, Madras and Visakhapatnam were collected.



Region-wise quarterly landings of Lizard fish during 1994

The lizard fish fishery showed an increasing trend at Bombay (1,314 t to 2096 t), Cochin (856 t to 916 t), Madras (1,570 t to 3049 t) and Visakhapatnam (187 to 255 t). At Veraval, however, the catch declined from 489 t to 353 t this year. There was increase in effort and catch at Visakhapatnam whereas at Veraval there was decline in effort as well as catch. At Calicut and Beypore also there were increases. The catch was dominated by *Saurida tumbil* at Bombay (85%) and Veraval (79%) and by *S. undosquamis* at Cochin (77%), Madras (100%) and Visakhapatnam (75%). From Mangrol near Veraval, lizard fishes with an estimated catch of 146 t was represented mainly by *S. tumbil* (80%). In Calicut and Beypore, *S. tumbil* dominated followed by *S. undosquamis*.

Polynemids were landed in trawl nets and gill nets (106 t) at Veraval and were represented by *Polynemus indicus*. At Dhamlej, polynemids were landed only in gill nets (136 t).

Flatheads landed at Veraval showed a decline from 173 t to 20 t. At Cochin also, the catch showed a decline from 23 t to 12 t. *Platycephalus maculipinna* was the major species at Cochin.

Biology and Fishery of Flat Fishes, Goat Fishes and White Fish (DF/RE/7)

P. Bensam, S. Lazarus, P.U. Zacharia, M. Feroz Khan, Grace Mathew, S. Krishna Pillai, P. Jayasankar, P. Devadoss and K.M.S.A. Hamsa

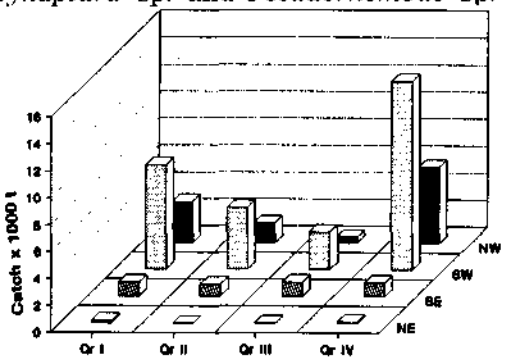
Flat fishes

An estimated 2204 t of flatfishes were landed at Mangalore and 915 t at Malpe with an average catch per unit of 28.5 and 41.4 kg respectively. Trawlers accounted for 99.5% of the catch. Postmonsoon period was the peak for this fishery. At Calicut 1269 tonnes were landed with catch per unit of 34 kg. The catch at Cochin declined during the current year with catch of only 209 t and catch rate of 6 kg. At Vizhinjam, the fishery was poor.

At Tuticorin, 17 t of flatfishes were landed and 245 t at Mandapam. Flatfishes did not form fishery at Madras and Visakhapatnam.

The Malabar Sole *Cynoglossus macrostomus* formed 90-97% along the west coast except at Vizhinjam.

C. macrolepidotus was the dominant species both at Tuticorin and Mandapam. Other species contributing to the fishery were *Psettodes erumei, C. dubius, Synaptura* sp. and *Pseudorhombus* sp.



Region-wise quarterly landings of Flatfish during 1994

C. macrostomus ranged from 4 to 17 cm with modes at 11 and 12 cm. Preadults occurred throughout the year in the fishery. Mature and spent fishes were more during September-December.

Goatfishes

An estimated 3,073 t were landed at Madras with a catch rate of 56 kg, where an increase of 21% was noticed over the previous year. At Mandapam a catch of 654 t and a catch rate of 5.23 kg were estimated.

In the Mangalore-Malpe region, there was no catch of goatfish. Calicut recorded a catch of only 4.13 t, and Cochin about 67 t.

Upeneus vittatus and *U. bensasi* were the principal species along the west coast. The catch on the east coast consisted of *U. vittatus, U. sulphureus, U. sundaicus, U. tragula, Parupeneus indicus, U. oligospilus, U. moluccensis* and *U. taeniopterus*. In the west coast *U. bensasi* ranged in length from 10 to 17 cm, with modes at 11 and 13 cm. Preadults were encountered throughout the year in the fishery. Mature and spent fishes occurred in good numbers during December-January.

In Madras region *U. bensasi* was dominant with the length range of 5-16 cm and mean size 10.5 cm. Males predominated and gravid females occurred in May-June, December and March in respect of *U. sulphureus*. In Mandapam, *U. sulphureus* ranged in length from 10 to 20 cm. Females predominated with dominant maturity stage at IV. At Visakhapatnam, *U. vittatus* ranged from 11 cm to 17 cm, mature females were recorded in February-March and stages I and II occurred throughout.

Whitefish

The estimated catch of whitefish varied from 7 to 38 t at different centres in Kerala. Maturity stages II-III occurred throughout while mature fishes were encountered during September-November.

Investigations on the Effect of Coastal Bottom Trawling on Juvenile and Spawning Populations of Demersal Finfishes and on Benthic Biota (DF/TR/1)

N.G. Menon, P. Livingston, P.U. Zacharia, P. Bensam, P. Jayasankar, E. Vivekanandan and A. Raju

Finfishes formed 40-65% of the total trawl catch in Karnataka and target groups like crustaceans and cephalopods 11-17%. The benthic organisms like squilla, inedible crabs, gastropods, bivalves, echinoderms formed 15-36% of the total catch, which are invariably discarded. Squilla composed of 90-96% of the benthic organisms. The discarded catch included juveniles of prawns, cephalopods and

finfishes like sciaenids, flatfishes, perches, flatheads and threadfin breams.

In Kerala finfishes formed about 49-54% of the total catch and target group, 23-46%. The discarded benthic organisms and other juvenile fish/shellfish together constituted 5-23% of the total catch. In the discarded catch the juvenile finfish alone accounted for 34% which included threadfin bream, lizardfish, flatheads, flatfish, sciaenids, silverbellies and perches. Among the benthic organisms inedible crabs were the most abundant followed by squilla, gastropods etc.

The mini trawlers landed an average catch of 200 kg/unit effort along Alleppey-Ernakulam District from the 5-15 m depth zone. About 50% of the catch composed of *P. stylifera* and finfishes like sciaenids, flatfish etc. The remaining 50% composed of juveniles of unmarketable *P. stylifera*, flatfish, sciaenids and a variety of benthic organisms like tube dwelling polychaetes, squilla, crabs, gastropods, echinoderms etc. which were discarded.

In Tamil Nadu, finfishes formed 60-62% of the total trawl catch and the target groups 10%. The discarded benthic catch formed 4-14% of the total catch which included benthic organisms like squilla, inedible crabs, gastropods, echinoderms, and juveniles of prawns, cephalopods and finfishes like threadfin breams, sciaenids, silverbellies and flatfishes.

In Andhra, finfishes formed about 68% of the total catch, the target group like crustaceans and cephalopods 30% of the total catch. The remaining 2% consisted of benthic organisms like inedible crabs (70%), stomatopods (27%) and juveniles of carangids, sciaenids, goatfishes, perches, flatfishes, prawns and cephalopods.

Broodstock Development of Seabass and Selected Species of Perches (DF/CUL/3)

R. Marichamy, P. Jayasankar, V.S. Rengaswamy

At Tuticorin, from the initial stocking size of 75.5 mm (8g), the fish grew to 307.8 mm (401.2 g) in 12 months period, recording a monthly average growth rate of 21.1 mm (35.8 g).

At Mandapam, infrastructure facilities such as a 3-layer filter was established to supply pure water in the 35 t capacity tank; and an old 200 t fibreglass tank was converted into a filter. Fresh sea water supply was also provided to maintain salinity. 46 live groupers (*Epinephelus* spp) in the size range of 120-470 mm (40 g to 1.6 kg) were examined for gonadial development and found to be immature. They were fed with dead sardines, prawns and live fishes at a rate of 5-10% of the body weight. Four live seabass of the length range 600-800 mm and weight range 4-6 kg were examined to assess gonadial development. The ova diameter was found to be 0.09 mm only. They were fed with live tilapia, dead sardines, mullets and milkfish at a rate of 10% of the body weight.

Experiments were also conducted on environmental manipulation by increasing the salinity from 20-25% to 32-35% gradually. Attempts were made by maintaining the fish at low volume of water at noon for 3-5 hours and then adding water for reducing the temperature and simulating a tidal effect. For the first time on a trial basis, LH-RH ethylamide pellets were implanted in the fish, by implanting through a 5 mm incision on the abdominal muscle and oxytetracycline was

applied over the injury. The pellet-implanted fishes recovered quickly and were active. But no significant results were obtained either by environmental manipulation or by LH-RH pellet implantation.

Survey and Assessment of Ornamental Fish Resources of Lakshadweep

P. Vedavyasa Rao and V. Sriramachandra Murty

This project is sponsored by the Department of Agriculture, Government of India. During the year, the survey was continued in eight islands of the Lakshadweep, using gill nets of different mesh sizes, encircling nets and traps. A total of 5393 specimens of ornamental fish representing 128 species were collected.

The data collected were analysed with respect to 12 dominant families. The preliminary results showed that the family Labridae (wrasses) is most abundant constituting 37.1% of total population of all these 12 families in all the eight islands (Chetlat, Kiltan, Amini, Kadamat, Kalpeni, Bitra, Kavaratti, Agatti) together and Pomacanthidae (angels) is least abundant (0.1%). The other groups in the order of abundance are Pomacentridae (damsel fish) (31.9%), Callyodontidae (parrot fish) (8.4%), Mullidae (goat fish) (8.2%) Holocentridae (squirrel fish) (4.7%), Acanthuridae (surgeon fish) (4.6%), Chaetodontidae (butterfly fish) (2.1%), Serranidae (groupers) (1.2%), Balistidae (trigger fish) (0.8%), Canthigasteridae (Puffer fish) (0.6%) and Zanclidae (moorish idol) (0.4%).

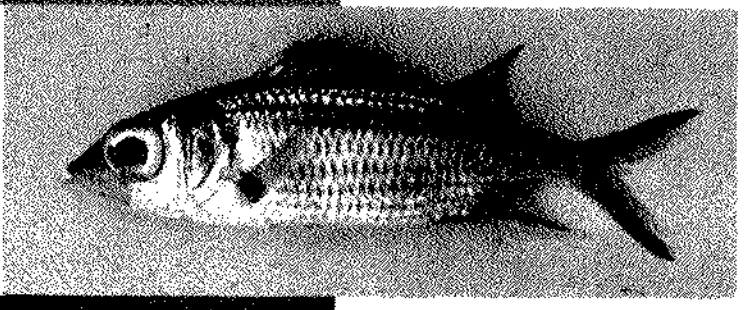
A total of thirty species of wrasses were collected of which *Halichoeres centriquadrus, H. scapularis, H. marginatus, H. kawarin, Thalassoma hardwickii* and *Stethojulis axillaris* are most abundant. In damsel fish a total of 22 species were collected and *Chromis caeruleus, Dascyllus aruanus, D. reticulatus, Abudefduf sexfasciatus, A. glaucus* are dominant. Of the 10 species of the goat fishes collected, *Mulloidichthys samoensis, Parupeneus barberinus, P. macronemus* and *M. auriflamma* are dominant. In surgeon fishes, of the 13 species collected, *Ctenochaetus strigosus, Acanthurus triostegus, A. leucosternon, A. lineatus* and *A. matoides* are most dominant. Among butterfly fishes, 12 species were collected and *Chaetodon auriga, Megaprotodon strigangulus, C. trirasciatus, C. falcula, C. xanthocephalus* are dominant. In parrot fishes, *Callyodon taeniurus, C. sordidus* and *C. bataviensis* are most abundant among the 9 species collected. In squirrel fishes, 9 species were collected of which *Neoniphon sammara, Sargocentron punctatissimum, S. caudimaculatum* and *Myripristis murdjan* are dominant. Among groupers, 9 species were collected and *Epinephelus merra, E. hexagonatus* and *Cephalopholis argus* are dominant. In the trigger fish, *Rhineacanthus aculeatus* is most dominant and among angel fish, *Centropyge mutlispinis*.

Of the eight islands covered so far, Kalpeni appears to be the richest in regard to the population size of ornamental fishes of the above 12 families accounting for 28.8% of the total population in the eight islands, followed by Amini (27.6%), Kadamat (15.4%), Chetlat (9.2%), Kavaratti (7.4%), Agatti (6.3%), Kiltan (3.2%) and Bitra (2.2%).

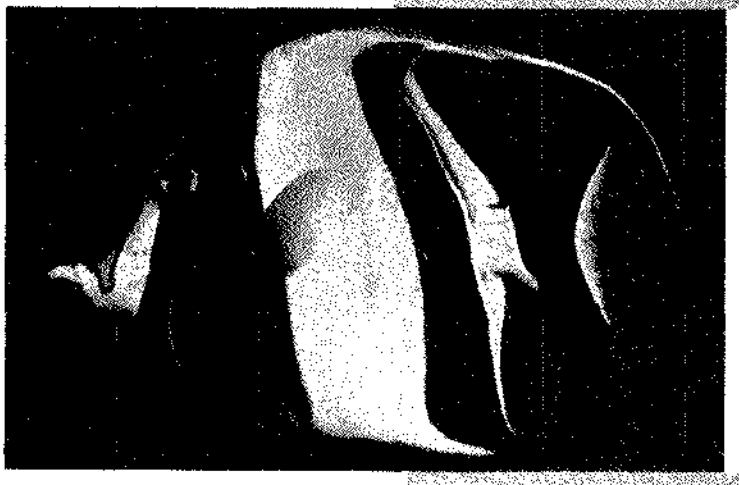
Data on length composition, maturation and food of dominant species are collected, the survey and analyses of data are progressing.

Important ornamental fishes of Lakshadweep

Chaetodon auriga (Butterfly fish)



Neoniphon sammara (Squirrel fish)

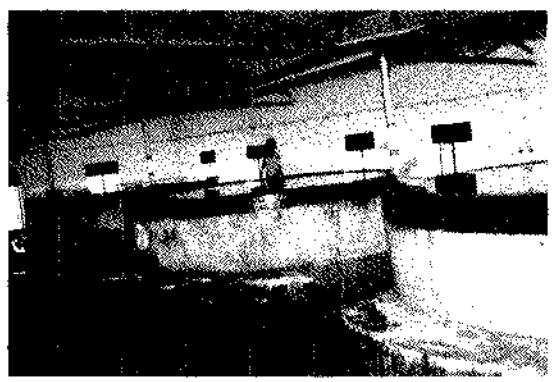


Zanclus canescens (Moorish idol)

Epinephelus hexagonatus (Grouper)

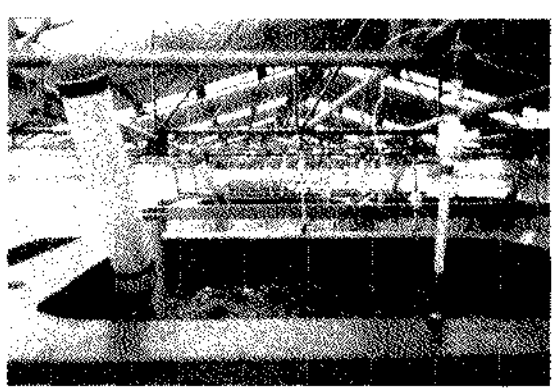
P. monodon hatchery constructed under the consultancy programme of CMFRI in Andhra Pradesh

Sea water chlorination Unit



Rematuration facility

Open phytoplankton culture facility



Larval rearing facility

IV. Crustacean Fisheries Division

Investigations on the Exploitation, Management and Conservation of Penaeid Prawn Resources of the West Coast of India (CF/RE/1.11)

C. Suseelan, V.D. Deshmukh, M. Aravindakshan, V.S. Kakati, E.V. Radhakrishnan, K.N. Rajan, K.R. Manmadhan Nair, Mary K. Manissery, P.E. Sampson Manickam, G. Nandakumar and K.K. Philipose

With an estimated landings of 1,62,088 t, the west coast of India contributed 76% of the total panaeid prawn catch of the country which was estimated at 2,12,329 t during 1994. Kerala topped in the production with a catch of 71,871 t followed by Maharashtra (52412 t), Gujarat (26770 t), Karnataka (8418 t) and Goa (2617 t). Penaeid prawn landings on the west coast registered an increase of 22% over the previous year. When compared to the previous year, maximum increase was recorded in Karnataka (86%) followed by Kerala (49.8%), Goa (18.8%) and Gujarat (13.1%). Maharashtra showed a marginal decline of 4.3% over the previous year. Kerala's penaeid prawn production in 1994 was the highest since 1975.

Investigations on prawn resources were carried out at Veraval, Bombay, Karwar, Mangalore, Calicut, Kochi and Vizhinjam along the west coast.

Trawl Fishery: Over 84% of the penaeid prawn landings on the west coast was accounted by trawlers. The percentage contribution of trawlers in the penaeid prawn fishery amounted to 86.4 in Kerala, 84.5 in Karnataka, 82.5 in Goa, 93.8 in Maharashtra and 55.9 in Gujarat. Penaeid prawn landings during 1994-95 registered increase over 1993-94 to the extent of 10% at New Ferry Wharf (Bombay), 30% at Mangalore, 22% at Malpe, 25% at Calicut, 72% at Cochin Fisheries Harbour. Landings declined by 14% at Veraval, 2% at Karwar, 42% at Tadri and 29% at Sakthikulangara and Neendakara. The catches at different centres were 3612 t (51 kg/boat trip) at Veraval, 17780 t (611 kg/boat trip) at New Ferry Wharf, 420 t (24 kg/boat trip) at Karwar, 298 t (38 kg/boat trip) at Tadri, 1996 t (47 kg/boat trip) at Mangalore, 1002 t (46 kg/boat trip) at Malpe, 1344 t (36 kg/boat trip) at Calicut, 11404 t (121 kg/boat trip) at Cochin and 12064 t (66 kg/boat trip) at Sakthikulangara and Neendakara. Trawling operations were suspended during the monsoon period at Veraval, Karwar, Tadri, Mangalore, Malpe and Calicut. Monsoon trawling was banned for about 35 days beginning from the middle of June along the Kerala coast. Trawling was intense during the rest of the monsoon period at Cochin and Sakthikulangara-Neendakara harbours.

Extremely good landings (8091 t) of *Parapenaeopsis stylifera* were recorded in the monsoon months at Cochin against 1700 t in the previous year. However, the same declined at Sakthikulangara from 10778 t in 1993 to 6244 t in 1994.

With the extension of trawling to deeper grounds and introduction of multiday and night trawling operations, nonconventional resources like *Metapenaeopsis* spp, *Trachypenaeus* spp, *Solenocera* spp, *Penaeus canaliculatus* and

P. semisulcatus have gained prominence in recent years. Of this *Metapenaeopsis stridulans* (10%) at Bombay, *Solenocera* sp. (7%) and *Trachypenaeus* sp. (9%) at Mangalore and *Trachypenaeus curvirostris* (18%) at Sakthikulangara supported sizeable fisheries. *P. canaliculatus* and *P. semisulcatus* supported minor fisheries at Mangalore, Cochin and Sakthikulangara. These species fetched very high price in export market.

P. stylifera dominated the trawl fishery at most of the trawling centres, the percentage contribution being 40 at Veraval, 34 at Bombay, 76 at Karwar, 59 at Tadri, 55 at Calicut, 78 at Cochin and 62 at Sakthikulangara. *Metapenaeus monoceros* formed the main component at Mangalore (44%) and Malpe (48%). Other important species supporting the penaeid prawn fishery were *S. crassicornis* at Veraval (35%) and New Ferry Wharf (12%), *M. dobsoni* at Karwar (18%), Tadri (24%), Malpe (17%), Calicut (24%) and Cochin (14%) and *T. curvirostris* at Sakthikulangara (18%). Species like *P. penicillatus*, *P. merguiensis* and *P. japonicus* supported minor fisheries along the north west coast.

In *P. stylifera*, the dominant size classes (combined for both sexes) supporting the fishery were 86-100 mm at Veraval 81-90 mm at Bombay, 86-95 mm at Karwar, 91-115 mm at Tadri, 71-90 mm at Mangalore and Malpe, 71-100 mm at Calicut, 71-95 mm at Cochin and Sakthikulangara. 61-90 mm sized *S. crassicornis* dominated the fishery at Bombay. In *M. dobsoni*, dominant size classes were 91-105 mm at Tadri, 81-105 mm at Karwar, 61-75 mm at Mangalore and Malpe and 101-125 mm sized *M. monoceros* formed the bulk of the fishery. *T. curvirostris* fishery at Sakthikulangara was dominated by 56-80 mm lengths.

Artisanal Fishery: 'Chakara' was less active in the monsoon months of 1994 along the Ambalapuzha coast of Kerala. Total prawn landings in 'Chakara' at Ambalapuzha amounted to 732 t of which *M. dobsoni* contributed to 96% followed by *P. indicus* 3% and *P. stylifera* 1%. 81-105 mm sized 'poovalan' (*M. dobsoni*) dominated the fishery. 40 to 50% of the prawns were in spawning condition.

At Fort Kochi, ring seines landed 30 t of prawns (9 kg/unit) during the monsoon period. Constituent species were *P. indicus* (72%) and *M. dobsoni* (27%). In 'Naran' (*P. indicus*) 121-130 mm sized prawns dominated the fishery.

Minitrawl operations at Valanjavazhi (Kerala) landed 544 t (27 kg/unit) of prawns between September 1994 to March 1995. 92% of the catch was contributed by *P. stylifera* and 7% by *M. dobsoni*. 51-85 mm sized 'Karikkadi' dominated the fishery. Under-sized prawns (below 70 mm in size) supported 40 to 45% of the prawn catch.

'Konchu vala' operations at Vizhinjam and Manakudy together landed 47 t of prawns at a catch rate of 1.4 kg/unit. 'Naran' (*P. indicus*) supported 83% of the fishery. Large sized prawns 156-185 mm in length dominated the fishery.

As regards the juvenile prawn fishery of estuarine environment, the stake nets at Korapuzha estuary landed 153 t (16.5 kg/unit) of which *M. dobsoni* formed 71.7% followed by *M. Monoceros* (18%) and *P. indicus* (10.3%). Dominant sizes supporting the juvenile fishery were 46-55 mm in *M. dobsoni*, 76-85 mm in *M. monoceros* and 76-95 mm in *P. indicus*.

INVESTIGATIONS ON THE EXPLOITATION, MANAGEMENT AND CONSERVATION OF PENAEID PRAWN RESOURCES OF THE EAST COAST OF INDIA (CF/RE/1.12)

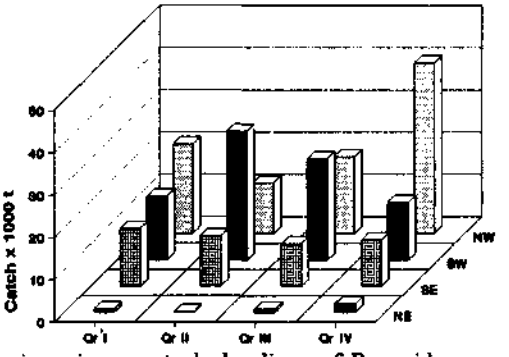
G. Sudhakara Rao, K.N. Saleela, V. Thangaraj Subramanian, G. Maheswarudu and M. Rajamani

In 1994 the total penaeid prawn production from the east coast amounted to 50,241 t against 41,856 tonnes in the previous year. East coast contributed to 23.66% of the total penaeid prawn production in the country. Statewise landings amounted to 30176 t in Tamilnadu, 16613 t in Andhra Pradesh, 2520 t in Orissa, 1247 t in West Bengal and 785 t in Pondicherry. Penaeid prawn landing registered an increase of 53% over the previous year in Tamilnadu and 43.8% in Pondicherry. Landings declined by 55% in West Bengal, 16% in Orissa and 4% in Andhra Pradesh.

Trawlers contributed to 90% of the penaeid prawn landing along the east coast. Investigations on the penaeid prawn fishery were carried out at Tuticorin, Mandapam, Madras, Kakinada, Visakhapatnam, Puri and Paradeep.

Trawl Fishery: Penaeid prawn landings by trawlers during 1994-95 increased by 97% at Tuticorin, 52% at Madras, 38% at Kakinada and 57% at Visakhapatnam over the previous year. However landings declined by 90% at Mandapam and 20% at Paradeep. The estimated penaeid prawn landing amounted to 775 t (5.7 kg/hr) at Tuticorin, 737 t (1.4 kg/hr) at Mandapam, 307 t (2.1 kg/hr) at Pamban 4777 t (17.5 kg/hr) at Madras, 7708 t (7.3 kg/hr) at Kakinada, 511 t (2.4 kg/hr) at Visakhapatnam and 1285 t (9.3 kg/hr) at Paradeep.

Dominant species supporting the fishery was *M. dobsoni* at Tuticorin (45%), Madras (20%), and Paradeep (23%). *Penaeus semisulcatus* supported the bulk of the prawn catch at Mandapam (42%) and Pamban (50%). *Metapenaeus monoceros* was the dominant constituent at Visakhapatnam (25%) and Kakinada (52%).



Region-wise quarterly landings of Penaeid prawns during 1994

Other important species supporting the fishery were *P. semisulcatus* (19%) and *P. stylifera* (15%) at Tuticorin, *M. stridulans* at Mandapam (39%), *P. maxillipedo* (26%) at Pamban, *P. indicus* (16%) and *P. maxillipedo* (14%) at Madras, *S. crassicornis* (8%) and *M. brevicornis* (9%) at Kakinada, *Solenocera* sp. (23%) and *M. dobsoni* (13%) at Visakhapatnam, *Parapenaeopsis* spp. (24%) and *M. affinis* (15%) at Paradeep. Visakhapatnam (2%) and Paradeep (1%). *P. merguiensis* were available in small quantities at Paradeep, Visakhapatnam and Kakinada.

Dominant size classes supporting the fishery in *P. semisulcatus* were 126-165 mm at Tuticorin, 111-135 at Mandapam and 111-160 mm at Paradeep. In *M. dobsoni* dominant size classes were 71-95 mm at Madras, 66-100 mm at Paradeep and 61-80 mm at Kakinada. 121 to 155

mm sized *M. monoceros* dominated the fishery at Visakhapatnam and 76-110 mm at Kakinada.

About 200 'sona' boats (43 ft in length) based at Visakhapatnam carried out trawling operations along the Orissa and West Bengal coasts and landed 1165 t of prawns at a catch rate of 260 kg/boat trip against 1224 t and 195 kg/boat trip respectively in the previous year. *M. monoceros* (25%), *M. dobsoni* (35%), *P. indicus* (8%), *M. affinis* (8%), *Metapeneopsis* spp. (9%) and *P. monodon* (6%) were important constituents of the fishery.

Because of poor catch majority of large and mini trawlers were lying idle at Visakhapatnam. Only 60 out of 190 large trawlers and 15 out of 90 mini trawlers conducted trawling operations during the year. Catch and catch rates were no better than the previous year.

Deep sea fishery: Deep sea trawlers based at Tuticorin carried out trawling operations at depths ranging between 100 to 200 fathoms and landed 335 t of prawns of which *Metapenaeopsis* spp. supported 49%, *Heterocarpus* spp. 28%, *Plesionika* spp. 14% and *Solenocera* sp. 9%.

Artisanal fishery: In the artisanal sector, gill nets landed 163 t (0.6 kg/unit) at Puri and 2.5 t (1.6 kg/unit) at Tuticorin. *P. indicus* dominated the fishery at Puri (87%) and Tuticorin (100%). *M. affinis* (6.7%) and *P. merguiensis* (5.6%) supported minor fisheries at Puri. 106-130 mm sized *P. indicus* dominated the fishery at Tuticorin. Spawners were rarely represented in the fishery.

"Thallumadi" (boat seine) operations at Tuticorin landed 57 t of prawns at a catch rate of 5.7 kg/unit at Tuticorin. Prawn landings showed an increase of 162% over the previous year. *P. semisulcatus* (69%) and *P. indicus* (17%) were the major components of the fishery. 91-140 mm sized *P. semisulcatus* formed the bulk of the fishery.

Juvenile Prawn Fishery: Stake net operations in Kakinada back waters landed 245 t of prawns at a catch rate of 21 kg/unit. Fishery was dominated by *M. monoceros* (52%), *P. indicus* (12%) and *P. semisulcatus* (10%). 46-70 mm sized *M. monoceros* formed the major portion of the catch.

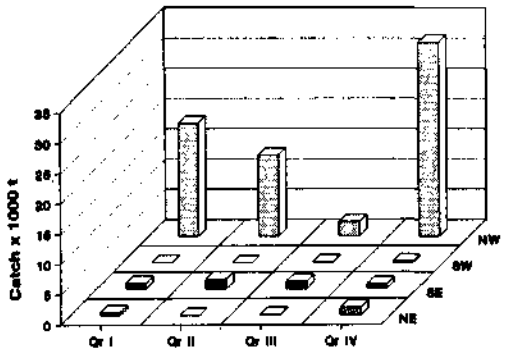
At Chinnapalam (Mandapam) 'Thalluvalai' landed 10 t of *P. semisulcatus* at a catch rate of 1.1 kg/unit. Juveniles of 83-123 mm sizes dominated the fishery.

INVESTIGATIONS ON THE EXPLOITATION, MANAGEMENT AND CONSERVATION OF THE NON-PENAEID PRAWN RESOURCES OF NORTH WEST COAST OF INDIA

(CF/RE/1.13)

V.D. Deshmukh, K.K. Philippose

With an estimated production of 80,036 t in 1994, nonpenaeids showed an improvement of 16% in the fishery over the previous year. Gujarat (62.8%) and Maharashtra (20.6%) together contributed to the bulk of the nonpenaeid catch in the country. 'Dol' net accounted for 71% of the non penaeid catch in Maharashtra and trawlers for 22%. In Gujarat, trawlers landed 81.5% and 'Dol' net 17.8% of the nonpenaeid catch. Investigations on the nonpenaeid resources were carried out at Nawabunder and Rajapara in Gujarat and Versova and New Ferry Wharf (Bombay), in Maharashtra. In Gujarat, studies were carried out on 'dol' net fishery while they were conducted on 'dol' nets and trawl fishery in Maharashtra.



Region-wise quarterly landings of Non-penaeid prawns during 1994

'Dol' net Fishery: At Versova and New Ferry Wharf 'Dol' nets landed 2216 t (22.4 kg/haul) and 117 t (18.8 kg/haul) of non penaeid prawns respectively. At Nawabunder and Rajapara, landings were estimated at 2267 t (13.5 kg/haul) and 3604 t (17.3 kg/haul) respectively. When compared to 1993-94 the catch showed 45.6% and 17.7% decline at Versova and New Ferry Wharf whereas it showed an increase of 9.9% and 20.5% at Nawabunder and Rajapara. Catch rates declined at all the above centres.

Due to the conversion of 'dol' net boats into trawlers at Bombay, the effort showed considerable decline (30.2%) at Versova. However in Gujarat, effort showed increase.

Acetes spp. dominated at Versova (79%) and New Ferry Wharf (83%), *Nematopalaemon tenuipes* contributed to 20% at Versova and 13% at New Ferry Wharf. The rest of the fishery was accounted by *Exhippolysmata ensirostris*.

As in Maharashtra, *Acetes* spp. dominated the fishery at Nawabunder (67%) and Rajapara (56%). *E. ensirostris* (18%) and *N. tenuipes* (29%) were the second largest component of the fishery at Nawabunder and Rajapara respectively.

Trawl Fishery: Trawlers landed 500 t (31.5 kg/unit) and 2168 t (74.6 kg/unit) at Versova and New Ferry Wharf respectively. Landings declined by 11% at Versova whereas it increased by 2.4% at New Ferry Wharf. Catch rates declined by 16% and 1% respectively at the above centres.

N. tenuipes, formed 98% of the fishery at Versova and 97% at New Ferry Wharf. *E. ensirostris* accounted for the rest of the fishery. In *N. tenuipes*, the size ranged from 21 to 72 mm at Versova and from 32 to 70 mm at Nawabunder in the 'dol' net fishery. In the trawl catches 27-75 mm sized *N. tenuipes* were represented at New Ferry Wharf.

Peak breeding season for *N. tenuipes* in Maharashtra was in September whereas it was August and December in Gujarat. In *E. ensirostris* peak breeding season was in May at Bombay and May and July at Nawabunder.

Studies on Exploitation, Management and Conservation of Lobster and Crab Resources of Indian Coast (CF/RE/1.4)

N. Neelakanta Pillai, V.D. Deshmukh, V.S. Kakati, E.V. Radhakrishnan, Mary K. Manissery, C. Suseelan, K.K. Philippose, D.B. James, M. Rajamani, G. Maheswarudu, V. Thangaraj Subramanian and K.N. Saleela

Lobster: With an estimated production of 2746 t in 1994, lobster landings registered an increase of 47% over the previous year. Gujarat with a landing of 1319 t (48%) was leading in the fishery followed by 559 t (20.4%) by Tamilnadu, 443 t (16.1%) by Kerala and 405 t (14.8%) by Maharashtra. Trawlers accounted for the major share

(72.7%) in landings followed by Gill nets (9.9%). Investigations on the lobster fishery were carried out at Veraval, Bombay, Calicut, Vizhinjam, Tuticorin and Madras.

Lobster landings in trawler operations were estimated at 128 t (1.82 kg/boat trip) at Veraval, 63 t (2.2 kg/boat trip) at Bombay, 51 t (1.5 kg/boat trip) at Tuticorin and 124 t (2.3 kg/boat trip) at Madras. Lobster landings in 1994-95 registered increases at Tuticorin (30.5%) and Madras (103%) whereas fishery declined at Veraval (51.2%) and Bombay (32.1%).

Dominant species in the trawlers were *Thenus orientalis* at Veraval (62%) and Madras (92%), *Panulirus polyphagus* (100%) at Bombay and *Panulirus ornatus* (64.1%) at Tuticorin. Other important constituents of the fishery were *P. polyphagus* (38%) at Veraval, *P. homarus* at Tuticorin (35.8%) and Madras (8%).

An important feature in the lobster fishery was the total disappearance of sand lobster (*T. orientalis*) from Bombay waters due to overexploitation. This lobster supported nearly 45% of the fishery in trawlers until 1985.

Dominant sizes in *P. polyphagus* were 71-80 mm (carapace length) at Veraval and 171-200 mm (total length) at Bombay. 166-190 mm (total length) sized *T. orientalis* dominated the fishery at Veraval. In *P. ornatus* mean size ranged between 174 to 336 mm (total length).

Deep sea vessels fishing at a depth of 170 fathoms landed 30 t of *Puerulus sewelli* at Tuticorin, the catch rate being 11 kg/boat trip. Maximum landings (18.6 t) were recorded in October. When compared with the previous year, landings declined by 50%.

In the artisanal sector, lobster landings at Vizhinjam, Colachel and Muttom together amounted to 5.7 t at a catch of 0.7 kg/trap. Maximum landings were recorded between November to January. *P. homarus* supported the entire fishery. 56-95 mm sized lobsters (CL) supported the major portion of the fishery.

Bottom set gill nets at Kayalpattanam and Tharuvaikulam together landed 74.4 t at a catch rate of 3.8 kg/unit. The landings improved by 16.6% at Kayalpattnam and 53.5% at Tharuvaikulam. *P. ornatus* dominated the fishery by 69.8% and 83.1% respectively at the above centres. *P. homarus* supported the rest of the fishery. 151-265 mm sized *P. ornatus* (T.L.) dominated the fishery.

Crab: Total crab landings in 1994 were estimated at 28,961 t of which Tamilnadu contributed to 35% followed by Gujarat (22%), Kerala (17%), Andhra (11%), Maharashtra (6%) and Karnataka (5%). Trawlers exploited nearly 73% of the crab fishery. Investigation on crabs were caried out at Veraval, Bombay, Karwar, Mangalore, Calicut, Cochin, Vizhinjam, Tuticorin, Mandapam, Madras and Kakinada.

Trawlers landed 1948 t (2.9 kg/hr) at Veraval, 442 t (0.3 kg/hr) at Bombay, 7 t (0.4 kg/boat trip) at Karwar, 222 t (0.2 kg/hr) at Mangalore, 152 t (0.4 kg/hr) Tadri, 179 t (4.8 kg/boat trip) at Calicut, 100 t (0.1 kg/hr) at Cochin, 1287 t (4.7 kg/hr) at Madras and 332 t (0.4 kg/hr) at Kakinada. On comparison with the previous year, crab landings improved by 52% at Veraval, 57% at Bombay, 5% at Mangalore and 96% at Madras. Landings declined by 1% at Karwar, 7% at Malpe, 74% at Cochin and 19% at Kakinada.

Dominant species supporting the trawler landings were *Charybdis lucifera*

at Veraval (100%), *C. cruciata* at Bombay (60%) and Mangalore (70%), *Portunus pelagicus* at Karwar (51%), Calicut (43%) and *P. sanguinolentus* at Malpe (35%), Madras (38%) and Kakinada (44%). Other important constituent species were *P. sanguinolentus* (11%) and *P. pelagicus* (18%) at Bombay, *P. sanguinolentus* at Karwar (49%); *P. pelagicus* (19%) and *P. sanguinolentus* (11%) at Mangalore; *P. pelagicus* (30%) and *C. cruciata* (27%) at Malpe; *P. snguinolentus* (30%) and *C. cruciata* (27%) at Calicut; *Podophthalmus vigil* (17%) and *P. pelagicus* (11%) at Madras and *P. pelagicus* (39%) and *C. cruciata* (17%) at Kakinada. With the extension of trawling to deeper grounds in recent years, *C. cruciata* has emerged as an important constituent of the crab fishery along both coasts. When compared with the conventional species, this crab fetches a higher price in the market.

In the artisanal sector, crab landings were estimated at 74 t (3.4 kg/unit) at Vizhinjam, 140 t (12 kg/unit) at Tuticorin and 212 t (4.8 kg/unit) at Mandapam. *P. pelagicus* was the dominant species at Vizhinjam (84%), Tuticorin (99%) and Mandapam (97%).

Seed Production, Experimental Farming and Tagging of Marine Prawns (CF/CUL/1.9)

N. Neelakanta Pillai, K.R. Manmadhan Nair, P.E. Sampson Manickam, V.S. Kakati, E.V. Radhakrishnan, G. Maheswarudu and P.T. Sarada

At Mandapam camp, a series of experiments on the induced maturation, artificial insemination, spawning, larval rearing, farming and tagging of prawn were carried out. Experiments on the induced maturation of *P. indicus* without eye stalk ablation gave encouraging results. Adult specimens were maintained in pools fitted with recirculation facility; pH and salinity of water were controlled. Light intensity was controlled and animals were fed with polychaets, clam meat and squids. After 53 days, first spawning in captivity took place. Thereafter the prawns spawned at shorter intervals. Individual females spawned repeatedly 21-28 times within 250-300 days releasing each time 1.7 to 1.8 lakh nauplii. The average hatching rate was 65.84%.

One female of *P. monodon* (TL-258 mm and wt 150 g) after unilateral eyestalk ablation spawned twice releasing unfertilized eggs. After second moulting the female was subjected to artificial insemination and it matured and spawned after 5 days releasing 2.9 lakh nauplii (70% hatching rate). The same individual matured and spawned again after 4 days releasing 4.3 lakh nauplii at hatching rate of 78%.

3.62 lakhs hatchery-produced postlarvae of *P. semisulcatus* were sea-ranched.

Hatchery-produced seed of *P. indicus* and *P. semisulcatus* were further reared in ponds to a TL of 70 mm and above and were used for tagging experiments. 3882 *P. semisulcatus* and 3430 *P. indicus* were tagged and released in Palk Bay during March 1994. Monitoring of the tagged and released prawns was carried out upto September 1994. Recovery of the tagged prawns from the commercial catches continued for 80 days. 1.3% of tagged and released *P. semisulcatus* were recovered from trawl catches within 80 days. In the case of *P. indicus* tagged and released

specimens were recovered from trawl catches only for the first 27 days. A comparative study on the recovery of tagged specimens of both species indicated that *P. semisulcatus* took 75 days to travel the same distance covered by *P. indicus* in 22 days. Further, the absence of tagged and released *P. indicus* in the commercial catches after 27 days apparently indicates the possibility of its moving away from the fishing grounds faster than *P. semisulcatus*.

Under the consultancy work, a shrimp hatchery of 40 million capacity was designed by the Institute. The construction work was completed, the phytoplankton culture facility and rematuration facility were tested successfully.

A training programme on hatchery production of marine shrimp seed was organised by TTC/KVK in collaboration with CFD at Mandapam Camp. Training was imparted to 7 trainees from different states.

V. Molluscan Fisheries Division

Investigations on Resource Characteristics of Cephalopods (MF/RE/1)

M.M. Meiyappan, K.K. Joshi, Kuber Vidyasagar, K. Sunilkumar Mohamed, G.P.K. Achary, T.S. Velayudhan, P. Laxmilatha, K. Prabhakaran Nair, N. Ramachandran, A.P. Lipton, G. Syda Rao, R. Sarvesan

The Fishery

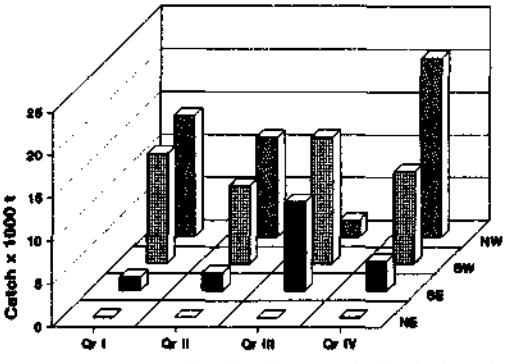
The cephalopod production in the country was estimated at 1,09,994 t (1994) registering an increase of 13,094 t over the previous year (96,900 t). Trawl net contributed to the bulk of the cephalopod landings. Indigenous gears were used in Vizhinjam area.

The cephalopod production in the various centres is as given below:

Centre	Estimated catch (t)	CPUE (kg)	% in Total	Cuttlefish (t)	Squid (t)
Veraval	2218	31	4	1195	1023
Mangrol	1598	61	6	771	827
Bombay	18245	361	14	7875	1037
Mangalore	3352	79	10	635	2717
Malpe	1782	81	13	707	1075
Calicut	468	12	—	214	254
Cochin	9526	107	17.5	—	—
Vizhinjam	479	*5	5.5	—	230
Visakhapatnam	285	8	6	223	52
Madras	3411	63	8	1666	1699
Rameswaram	452	7	2	352	81
Mandapam	166	5	2	146	18

* By boat seine

When compared to the estimates of 1993-94, the production in 94-95 increased by 27% at Malpe, 50% at Mangrol, 8% at Bombay, 17% at Calicut, 7% at Visakhapatnam 23% at Madras and 79% in the Mandapam/Rameswaram area. The production was less by 40% at Veraval, 3% at Mangalore. The catch rates showed increase of 4% at Bombay, 69% at Malpe and 3% at Madras and decrease of 42% at Veraval, 2% at Mangrol and 15% at



Region-wise quarterly landings of Cephalopods during 1994

Mangalore. The catch rate was the same as in the previous period at Calicut and Visakhapatnam.

SPECIES

a. *Cuttlefish*

S. aculeata: This species accounted for 19% of the cuttlefish catch at Veraval, 13% at Mangrol, 52% at Bombay, 43% at Mangalore, 56% at Malpe, 59% at Calicut, 58% at Mandapam, 82% at Rameswaram, 33% at Madras and 31% at Visakhapatnam.

S. pharaonis: Contributed 49% at Veraval, 48% at Mangrol, 43% at Bombay, 48% at Mangalore, 42% at Malpe, 41% at Calicut, 54% at Cochin, 39% at Mandapam, 17% at Rameswaram, 58% at Madras and 27% at Visakhapatnam.

Besides the above two important species, *Sepiella inermis* was landed at all centres except Veraval and its contribution varied from 1 to 30% at different centres. *Sepia elliptica* was landed in good quantities at Veraval and Cochin (14.8%).

b. *Squids*

L. duvaucelii: This species accounted for the entire squid catch at Veraval, Bombay, Mangalore, Malpe, Calicut, Cochin and Visakhapatnam and its composition varied between 1 and 64% at other centres.

Doryteuthis sibogae: Landed in good quantities at Madras throughout the year and it contributed about 31% to the squid production.

Sepioteuthis lessoniana: Contributed 94% to the squid landings at Mandapam and 64% at Rameswaram.

Octopus: Octopus landings at Madras composed of *Octopus dolfusi* (63%) and *Cistopus indicus* (38%). At Cochin, *O. membranceus* contributed 10% and *O. lobensis* 2%.

BIOLOGY

L. duvauceli: The size varied from 30 to 300 mm at Veraval 30 to 280 mm at Bombay, 30 to 270 mm at Mangalore, 60 to 230 mm at Cochin, 40 to 270 mm at Malpe, 40 to 140 mm at Visakhapatnam and 60 to 160 mm at Madras. Mature females were dominant at Veraval during Oct-Dec; during April-May, Oct-Nov and January at Mangalore, during May, October, November and January at Malpe and throughout the year at Madras. About 30-40% of the exploited squids were juveniles along the Indian coast. The stock of *L. duvaucelii* was estimated at 22,355 t with a MSY of 9,240 t for Bombay waters.

S. pharaonis: The size ranged from 80 to 310 mm at Veraval, 130 to 340 mm at Bombay, 70 to 290 mm at Visakhapatnam and 60 to 310 mm at Cochin. Mature females were dominant during October to February along Visakhapatnam coast.

S. aculeata: The size ranged from 40 to 240 mm at Bombay, 50 to 190 mm at Visakhapatnam and 40 to 180 mm at Rameswaram. Mature females were dominant during Oct-Dec period at Visakhapatnam.

INVESTIGATIONS ON THE CHARACTERISTICS OF BIVALVE AND GASTROPOD RESOURCES (MF/RE/2)

P.S. Kuriakose, K.K. Joshi, M.E. Rajapandian, K. Sunilkumar Mohamed P. Laxmi Latha, K.K. Appukuttan, T.S. Velayudhan, N. Ramachandran, K. Ramadoss, A.P. Lipton, P.V. Sreenivasan, P. Natarajan, R. Sarvesan

Green Mussel

The total production of green mussel (*Perna viridis*) between Challiyam and Koduvally along the Malabar coast was estimated at 3725 t. This was 1107 t less than the production during the previous year (4831 t). The total effort during this year ws 79,790 man-days and the average

catch rate was 46.7 kg per man-day. During this year maximum catch was recorded from Challiyam/South Beach Centres (91390 t). The size of the mussels in the commercial catch ranged from 50 to 130 mm withmodes at 85 mm and 110 mm. The price for 100 kg shell-on mussels at the landing centre varied from Rs. 400/- to Rs. 800/- and in the market the price varied from Rs. 450 - Rs. 1000/-. Spawning of green mussels started in July and spat settlement commenced in August. The average number of mussel seed was 775/m^2 in September 1994 and the size of seed ranged from 5 to 15 mm with mode at 10 mm.

Brown mussel

The estimated annual landing of brown mussel at 7 centres along the coast from Kovalam-Kolachel was estimated at 584 t and the total effort was 38,335 mandays. The average catch rate was 15.23 kg. The price of brown mussel varied from Rs. 10/- to Rs. 35/- for 100 mussels at the landing centre.

Clams

Details of clam production at various centres are given below:

Centre	Species	Estuary/area	Production
Cochin	—	—	No commercial fishing
Calicut	*Sunetta*	Korapuzha	10.8 t
	Villorita	Chettuva	324 t
Mangalore	*Meretrix casta*	Mulky	108 t
Karwar		Kalinadi	2.1 t
Kakinada	*Anadara granosa*		
	M. casta	Kakinada bay	1173.7 t
	M. meretrix		(30025 mandays)
	P. malabarica		
Veraval	—		No commercial fishing
Madras	*M. castra*		
	M. meretrix		
	K. opima	Kandaleru	1048 t
	A. granosa		(stock)
			(7.7 t Fishery)

Gastropods

Mandapam: The chank fishery was monitored at landing and collection centres at Rameswaram, Mandapam and Kilakarai. At Mandapam, 800 chanks were landed in trawl nets. During October-December, 400 chanks were collected from Mandapam for tagging experiments. Three tagged chanks were re-captured from Mandapam area after 1127-1209 days of their release.

Tuticorin: A total of 3,40,000 chanks were landed at Tuticorin. Average of 120 boats (6 persons/boat) were engaged in fishing.

A total of 228 live chanks (78-134 mm) were collected, tagged and 40% released in the open sea and rest inside the harbour basin. Two tagged chanks released in March 1992 and September 1994 were recovered. They showed a growth of 10 mm in 29 months.

Edible Oyster

Calicut: The total oyster exploited from Dharmadom estuary was around 4 t, Korapuzha 3 t and Kadalundi about 2.5 t. the price of edible oyster meat varied from Rs. 40 to Rs. 50 for one kg. A detailed survey of Dharmadom estuary showed that there are extensive oyster beds spread over an area of 10 hectares.

Madras: The total edible oyster (*Crassostrea madrasensis*) in the Krishnapatnam basin of Kandaleru estuary was about 650 t and the total area of oyster bed was about 14 hectares.

DEVELOPMENT OF HATCHERY TECHNOLOGY FOR EXPERIMENTAL/MASS PRODUCTION OF THE SEED OF CLAM, MUSSEL, EDIBLE OYSTER, PEARL OYSTER AND CHANK AND RANCHING OF CLAM AND CHANK SEED IN COASTAL WATERS (MF/CUL/4)

K.A. Narasimham, T.S. Velayudhan, P. Muthiah, K. Ramdoss, D. Sivalingam, A.C.C. Victor, A. Chellam, S. Dharmaraj, P.S. Kuriakose, G.P.K. Achary, K.K. Appukuttan, A.P. Lipton

Tuticorin

Pearl oyster hatchery: The spawning of *Pinctada fucata* on 11.3.1994 resulted in the production of 2,11,300 spats in the first quarter. 10,000 spat were shifted to the Valinokkam bay in May 94 and another group of 66,300 were transferred to the same area in June 94. The remaining 1,35,000 spats were shifted to the Tuticorin harbour farm. During the second quarter, the hatchery operations were suspended due to renovation of the overhead tanks and seawater supply system. In the third quarter there was spawning of the pearl oysters on 31.12.1994. By the end of the fourth quarter, a total of 1.31 lakhs of spats were raised by this spawning and they were ready for shifting to this farm. A total of 13000 pearl oyster spat of 8.6 to 16.4 mm length were sold to the Gujarat State Fisheries Department at Rs. 1300 and they were airlifted from Madurai to Jamnagar.

Training on pearl oyster hatchery was given to 4 candidates during 26.12.1994 to 20.1.1995. Mr. Machuri Maan, Scientist from Indonesia was trained in all aspects of pearl culture during 26.12.1994 to 28.2.1995.

The production of the live larval feed *Isochrysis galbana* in the hatchery was found inadequate, resulting in considerable mortality of larvae and early spats.

Edible oyster hatchery: A total of 7 successful experiments, resulting in spat production were conducted in the edible oyster, *Crassostrea madrasensis*. The oyster spawned during January-April, June, July and October. The larval settlement occurred between 21st and 30th day in all the experiments except in one case where it took 45 days apparently due to the low food supply. The spat production rate was generally low and a maximum of 3.55% was obtained. The settlement of spat on oyster shell cultch raised from 30 to 146 spats/shell. During the year a total of 923 strings were made comprising 5576 shells and with an average of 82 spats/shell. Overall spat production was 7,85,934. The ciliate attacks which got through the sea water filteration system and inadequate production of the microalga *Isochrysis galbana* resulted in lower spat production.

Clam hatchery: Four consignments of the clam *Paphia malabarica* were transported

from Ashtamudi to the clam hatchery at Tuticorin and maintained in the conditioning room. *Meretrix meretrix* brood stock collected at Tuticorin was also maintained. There was successful spawning in *P. malabarica* on 6 occasions during April, November and December, with two spawnings each in April and November. Spawning in April is of interest as it is outside the normal spawning period (October-December) of the species. A total of 2096 spat were raised from April 94 spawning. In the remaining 5 spawnings although spat settlement occurred there was heavy mortality due to ciliate attacks and breakdown of power and aeration facilities. A total of 45,472 spats of *P. malabarica* of 2.2 mm average length were transferred from the hatchery to the nursery in the Tuticorin bay on 16.3.95.

M. meretrix spawned on 23.4.94 and 25.4.94 and the spat settlement was observed on 8th day. By 9.5.94 there was total mortality of spat but reasons are not clear.

A total of 59,500 seed of *P. malabarica* ranging in length from 2.5 to 13.5 mm were ranched in the Ashtamudi at Dalawapuram on 8.3.95. The clams of 10.7 mm average length ranched in the Ashtamudi lake on 22.2.94 were harvested on 7.6.94 at mean size of 32.75 mm. The retrieval was 8%.

Live food production: The daily harvest of *Isochrysis galbana* ranged from 120 to 360 l except for some days when it went down to 60 l due to repairs in the hatchery. The stock culture of several microalgae were maintained in the phytoplnkton laboratory.

Calicut

Mussel hatchery: Two experiments were conducted on induced spawning of the green mussel *Perna viridis*. The larvae were reared upto the eyed stage. Poor water quality and the absence of filtration system prevented further rearing. Microalgae culture were maintained in the laboratory. Action was initiated to set up a mussel hatchery at Calicut with financial support from DBT.

Selection of Suitable Sites for Bivalve Culture (MF/CUL/8)

K. Satyanarayana Rao, K. Sunilkumar Mohamed, P.S. Kuriakose, K.K. Appukuttan, T.S. Velayudhan, A.C.C. Victor, A. Chellam, S. Dharmaraj, P.V. Sreenivasan, P. Natarajan, G. Syda Rao

In view of the encouraging results of preliminary experiments, oyster shell rens were set up in the following water bodies to monitor growth. The spat were transplanted from Tuticorin hatchery.

State	Water body	Initial length	Final length	Duration
Karnataka	Mulki estuary	32 mm	72 mm	8 months
Kerala	Dharmadam	30 mm	71.7 mm	8 "
	Korapuzha	30 mm	63.5 mm	8 "

The growth and survival rates indicate the suitability for large scale oyster culture in these areas.

Karwar: Culture experiments as well as spat fall studies were carried out in the lower reaches of Kali estuary. Observations on the hydrological conditions showed that low saline condition prevail till March in the Kali estuary.

Mangalore: Experiments were conducted to find the optimal sediment type suitable for growth of the clam, *Meretrix casta* using five different sediment types.

Calicut: Pearl oyster spat transferred from Tuticorin hatchery in October 1993, recorded good survival and a growth of 41.4 mm in 8 months.

A batch of 400 implanted pearl oyster and 1000 spat were transferred from Tuticorin during December 1994 and transplanted to Puthiappa Bay. Mortality was higher among the implanted oysters due to transportation stress. The spat which had a mean DVM of 18.11 mm recorded a growth of 45 mm by March. Heavy fouling of the rearing cages by ascidians, barnacles and tubiculous polychaetes was reported.

Tuticorin: Two batches of pearl oyster were reared near Pandian-thivu in the Tuticorin Bay. In one year, they reached 48 mm in DVM and 20 g in wt. Spat and operated oysters were transplanted to Valinokam Bay and were reared.

In the land-based pearl oyster farming, 1000 spat in two cages were suspended in a feeder canal of a prawn farm in Pattina marudu. Simultaneously a set of spat of similar size was also kept in Tuticorin Bay for comparative study. The growth of spat in the farm (from 17 mm to 28.8 mm, 3.2 g) was slower compared to that in the Tuticorin Bay (17 mm to 41.3 mm, 11 g) at the end of six months. This could be due to disturbance caused by continuous flow of water.

Madras: Based on experimental culture of edible oyster in the Krishnapatinam Basin conducted over a period of two and a half years, it was concluded that the area is suitable for conducting edible oyster culture using ren method.

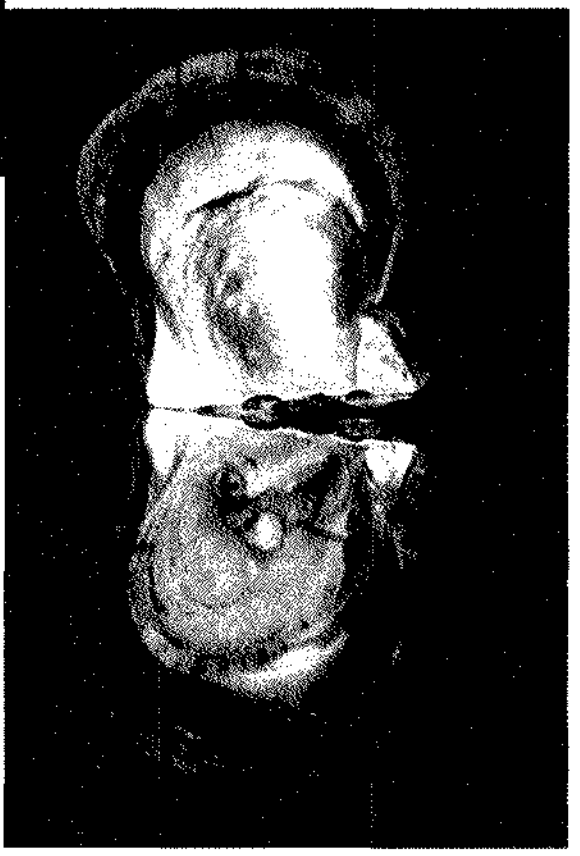
To extend the project work to areas south of Madras, a survey was conducted to identify suitable areas. Thenpakkam estuary near Marakkanam had oyster resources of 2,277 t distributed over 110.8 ha, live oysters constituting 28% of the resources. In the Chunnambanam estuary near Pondicherry, there were an estimated 11,145 t distributed over 98.8 ha. Live oyster population constituted 355 t.

Cochin: The oysters transplanted during 1993 at Ashtamudi and Cochin survived the vagaries of monsoon. Spat settlement was studied and 1,18,000 spat/825 strings, were successfully collected during the season. A total of 1,50,302 and 15 strings were transported to Tuticorin, Ayiramthengu and Chellanam respectively during this period.

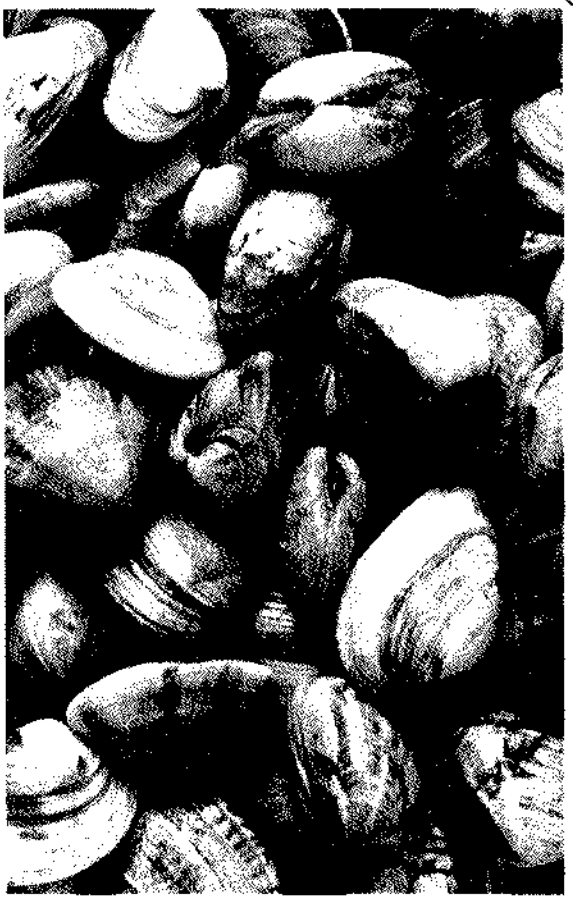
A rack of 0.242 ha was maintained at Ashtamudi area. The settlement of edible oyster spat/shell increased from 21 to 24 in 1994-95 period. The total weight of string was 3 kg/4 months period.

A total of 69 pearl oysters survived transportation stress (Nov. 1994) of which 33 were reared off Andhakaranazhi. 12 Nos. survived after six months. A 33% pearl production was noticed. Among the spat, 48 oysters reached adult size attaining 46.33 mm from 27 mm within 6 months (November 6 to May 27).

The edible oyster *Crassostrea madrasensis* harvested from the farm at Ashtamudi, Kerala

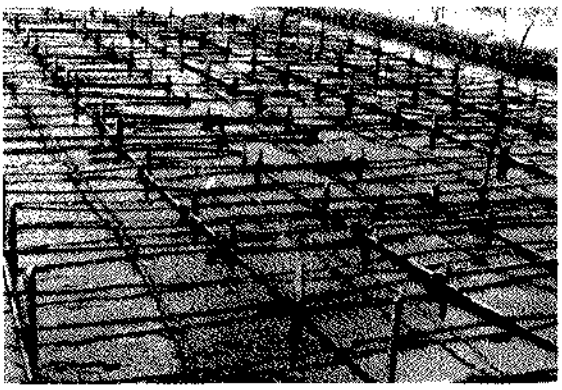


Pearl oyster with cultured pearl *in situ* from pearl oyster farm at Andhakaranazhi (Kerala)



Bivalve culture in Ashtamudi lake Quilon

1. Harvested edible oyster 2. Venerid clams



1. Edible oyster farm at Dalavapuram 2. Harvested clams

Pilot Project on Oyster Culture: Semi Commercial Production of Edible Oyster (MF/CUL/9)

P. Muthiah, K. Ramdoss, M.L. Arunmozhi Devi

Spat collection from wild was carried out during April-May '95 using 2500 edible oyster shell cultch. Of these, 700 shells were placed in netlon bags and placed on a rack. The rest were broadcast in the natural oyster bed. Netlon sheets of 50x30 dipped in mixture of cement, lime and sand and formed into cylinders were also suspended from a rack. Discarded motor cycle tyre pieces were also placed on the rack to serve as cultch.

For spat collection at Ashtamudi, 500 strings each having 6 shells/string in synthetic rope were supplied.

Strings numbering 150 with edible oyster spat settled at Ashtamudi were transported to Tuticorin. The length of oysters ranged from 28.5 to 51.4 mm with an average of 39.5 mm; number of oysters/string varied from 56 to 84 with an average of 74 spat.

The oyster farm with 55 racks having 1284 strings suspended from the racks was maintained and growth was monitored.

	After 3 months	After 6 months	After one year
Length of oyster (mm)	38-41	76.8-78	116-122
Weight of each string (kg)	2-2.5	3.5-4.5	6-10

The mean condition factor ranged from 63.6 in March 94 to 102 in January 95. The various hydrographic parameters were also monitored. High intensity of fouling (60 g/string) was observed in September and October 94.

Harvest: About 8 t of oysters were harvested from the farm in September 94. The weight of oyster ranged from 8 to 15 g. 500 kg of oyster meat obtained from the harvest was sold to Integrated Fisheries Project, Cochin. About 67.5 kg of oyster meat was sold locally.

Upgradation, Location Testing and Transfer of Technology of Pearl Culture (MF/CUL/10)

A.C.C. Victor, A. Chellam, S. Dharmaraj

The farming of oysters in the Valinokam Bay was continued during the year. A total of 76,334 spat produced in the hatchery were transferred to the farm in two batches - 10,014 nos. on 17.5.95 and 66,300 on 2.6.95, and reared in 22 net cages. However, in June 1994, the rack collapsed due to large sand bank formation near the farming site. A new rack was constructed 50 m away from this site and a fresh stock of 743 nucleated oysters was stocked in the farm.

A total of 9048 oysters were inplanted with nuclei of 2 mm, 3 mm, 4 mm and 5 mm dia. Totally 1110 pearls were

harvested; besides this a total of 488 pearls weighing 73.91 g were sold to the public and Rs. 53,180/- was realised.

Two consignments of spat and implanted oysters each containing 1250 spats and 400 nucleated oysters were successfully transported to Cochin and Calicut. Another consignment of 800 spats and 400 nucleated oysters was transported to Kakinada in January by train. During the transit, heavy mortality resulted at Madras due to exposure to low saline water for more than 10 hours.

A short term training course on "Pearl oyster farming and pearl culture" was conducted at TRC, CMFRI from 13.6.94 to 8.7.94. Seven candidates, two from CIFE, Bombay, three from M/s Oriental Commodities Network (P) Ltd; Bombay, one each from Goa and Tuticorin participated in the course. Another training programme, on pearl oyster farming and hatchery technology was conducted from 12.2.94 to 20.1.95 in which 4 candidates participated.

VI. Fishery Environment and Management Division

Investigations on Environmental Parameters in the Inshore Waters in Relation to Fisheries (FEM/ES/1)

M.S. Rajagopalan, C.P. Gopinathan, K. Rengarajan, G.S. Daniel Selvaraj, K.G. Girijavallabhan, V. Chandrika, S. Muthuswamy, T.S. Naomi, Molly Varghese, V.V. Singh, P.K. Krishnakumar, V. Narayana Pillai, C.V. Mathew, P. Kaladharan, P.A. Thomas, S. Jasmin, S. Krishna Pillai, M. Rajagopalan, K. Vijayakumaran, Pon Siraimeetan, P.T. Sarada and B.S. Ramachandrudu

Under this project, data on hydrography, primary and secondary production were collected regularly from the inshore waters of different centres.

Cochin: Inshore hydrography and plankton data at 20 m station indicated as follows: Sea Surface Temperature was 30.4°C in April and dropped to 25.7°C in August. Salinity was in the range of 31.74 - 30.64‰. Bottom oxygen values ranged from 2.72 ml/l (April) to 0.44 ml/l in August.

Surface chlorophyll *a* values ranged from 1.06 mg/m^3 to 9.68 mg/m^3 in August. Bloom of *Chaetoceros* spp. appeared in April. Bottom chlorophyll values were high in June at 10 m station. Maximum chlorophyll concentration was observed in May at 20 m station (9.88 mg/m^3). These values ranged from 2.14 to 3.20 at 10 m and 0.80 to 4.27 at 20 m during October-December.

Zooplankton values were high in August (294 ml/100m^3), swarming of siphonophores occurred during this month. In general, copepods, cladocerans, lucifers, fish eggs and larvae and appendicularians dominated the samples. Swarming of *Penilia avirostris* was observed in October.

Visakhapatnam: Sea surface temperature ranged from 25.95°C in May to 23.3°C in August. Salinity was around 34.0 ppt during the first two quarters. Nitrate, phosphate and silicate values were high in April. Moderate upwelling was observed from April to August.

Mandapam: During October-December 1994, maximum SST was observed in October (30.5°C) and minimum in November (26.8°C). Salinity varied from 32.0 to 32.8 ppt and oxygen from 4.67 ml/l to 5.46 ml/l. Primary production ranged from 17.14 mgC/m^3/hr to 86.9 mgC/m^3/hr in the Gulf of Mannar and from 12.48 to 60.8 mgC/m^3/hr in the Palk Bay.

Madras: During October-December at 20 m station SST ranged from 25.0°C in December to 29.5°C in October. Lowering of salinity was observed in November, 26.2 to 26.4 ppt. Dissolved oxygen values ranged from 4.1 ml/l to 5.2 ml/l.

Vizhinjam: Surface temperature ranged from 24.3 to 25.2°C; salinity 34.36 to 34.85 ppt and dissolved oxygen from 4.78 to 4.93 ml/l during October-December '94. Gross primary production had average values of 428 mgC/m^3/day.

Calicut: Surface temperature during October-December ranged from 28-30°C; salinity from 31.12 to 34.25‰, dissolved oxygen from 3.54 to 4.09 ml/l and the nutrients such as phosphates and nitrates were high, 0.83 and 2.64 µ at/l respectively.

Minicoy: In the inshore area, surface temperature was maximum in April and minimum in July. The salinity values also showed a peak during March-April and decline during August-September, (34.00 ppt to 31.8 ppt). The dissolved oxygen content showed a range of 4.8 ml/l to 5.3 ml/l during the postmonsoon period.

Average zooplankton volume was low in December (0.6 ml) and moderate in November (4.0 ml). Foraminifers, fish eggs, sinphonophores, copepods, echinoderm larvae dominated the samples.

Mangalore: During the post-monsoon, SST ranged from 28.0 to 29.8°C; salinity ranged from 16.9 ppt to 34.8 ppt; dissolved oxygen varied from 4.08 to 5.16 ml/l. Surface primary production was high in December (347 mgC/m³/day).

Karwar: Surface temperature was high in the range 30.0 - 31.2°C during April-May and dropped to 26.5°C in September. Salinity which was at 31.13 ppt in May lowered to 8.29 ppt in August. Low dissolved oxygen values were observed in September. Salinity values recoverd to 32.7 ppt in November and SST to 29.2°C but dropped again in December to 25.5°C.

Bombay: SST was high in May (31.8°C) and low during July (29.20°C) and reared to 31.00 in September, pH was in the range 7.4 to 8.0. Dissolved oxygen values were low during June-September (average 3.67 ml/l). Salinity values ranged from 34.25 to 35.0 ppt during April-June and 12.03 to 17.87 ppt during July-August and increased to 34.15 ppt in November.

Kakinada: SST was in the range 27.17 to 30.0°C during July-September and 24.36 to 30.75°C during October-December. Salinity ranged from 25.59 to 32.57 ppt and dissolved oxygen ranged from 3.28 to 5.0 ml/l. Salinity was lower at 14.53 to 24.87 ppt during October-December.

Tuticorin: SST ranged from 25.4 to 29°C and salinity from 31.26 to 34.72 ppt. In comparison, SST was maximum in May, 30.4°C and salinity was 36.2 ppt in June. Average primary production was 492 mgC/m³/day and average zooplankton volume for the post-monsson was 21.0 ml (10 mnt. surface haul). Predominant groups were copepods, lucifer, decapods and chaetognaths.

Environmental Ecology on Coastal Zone and Mapping of Potential Sites for Seafarming (FEM/ES/5)

G.S. Daniel Selvaraj, Molly Varghese, M. Rajagopalan, C.V. Mathew and B.S. Ramachandrudu

The hydrographic and plankton data collected from the Chandragiri and Nileswar estuaries during 1990-92 were analysed season-wise.

Mean surface water temperature showed remarkable variation in the monsoon season among these estuaries with relatively higher values (26.3°C) obtained in the Nileswar estuary and lower values (25.6°C) in the Chandragiri estuary during the three seasons. Among the seasons, monsoon recorded highest oxygen values (4-5 ml/l) in both estuaries. Highest primary production was recorded in the Nileswar estuary (833 mgC/m³/day) during post-monsoon season. Zooplankton biomass indicated very low values (less than 0.5 ml per 5 minutes haul) in these estuaries. The study indicated that the

coastal water bodies around Chandragiri and Nileswar were low productive zones.

Apart from these, ecological investigations were carried out along the coastal waterbodies around Cochin in connection with the outburst of the Isopod, *Cirolana fluviatilis* population causing destruction to prawns and fishes.

Monitoring Marine Pollution in Relation to Protection of Living Resources (FEM/MP/1)

V. Kunjukrishna Pillai, C.P. Gopinathan, P.K. Krishnakumar, D. Kandasamy, P. Kaladharan and K. Vijayakumaran

The project was implemented at Cochin, Karwar, Mangalore, Vizhinjam and Tuticorin.

Cochin: Samples for hydrography, biology and sediment were collected at fortnightly intervals from four stations covering from estuary to 20 m depth zone off Cochin.

In water, higher levels of ammonia (64-68 µg at/l) and inorganic phosphate (52-57 µg at/l) were recorded in the estuarine area during the month of May, apparently due to run-off from industrial area around Cochin. Water temperature and dissolved oxygen levels were very low in the 20 m depth zone during August indicating upwelling phenomena in the inshore area. In the sediment, lead levels were comparatively more during April (86.5 mg/g) compared to other months.

In the consultancy programme on monitoring of water and sediment parameters to assess the effect of dredging in the harbour area for reclamation project in Wellington Island, data on 16 parameters are studied from 3 stations at fortnightly intervals from January 1994.

Karwar: Water samples from 3 stations, sediment from one station and biological samples from two stations were collected and analysed. In the tissue of oysters collected from the impact area, mercury levels were rather high (0.403 µg/g) compared to the levels in the samples collected from cleaner area. The observation indicated that effluents containing mercury are still discharged into the stream reaching Binega Bay at Karwar.

Mangalore: Baseline hydrographic survey was conducted at Nandikur, 50 km north of Mangalore where a super-Thermal Power Station is under construction. The data will be useful for future comparative and impact assessment studies in the environment near the site.

Tuticorin: Core samples from 3 stations were collected and taken to the Marine Geology Division of NIO, Goa for geological analysis to estimate the fly-ash component in the sediment and results are awaited.

Remote Sensing and Fisheries (FEM/RS/1)

M.S. Rajagoplan, G. Subbaraju, V.N. Pillai, K.G. Girijavallabhan, T.V. Sathyanandan, N.G.K. Pillai, Grace Mathew and K. Vijayakumaran

Information on potential fishing zones and sea surface temperature, derived from satellite data was regularly received from NRSA. Data inputs to the system in the

form of physical data sets, chemical data sets, chlorophyll and CTD data based on the recent cruises covering 300 stations have been entered. Data/charts on potential fishing zones received from NRSA are passed on to fishermen associations. Federation, Matsyafed etc. for their utilization and feed back.

Awareness programmes were conducted by NRSA project scientists at Quilon, Quilandy, Cannanore, Munambam and Cochin Fisheries Harbour. Potential Fishing Zones charts/telegrammes are now being sent to all Research Centres and Field Centres. Under a MARSIS application Project, CMFRI, FRAD staff are collecting data from all zones with remarks on PFZ valid for the day/centre. These are scrutinised and MARSIS, duplicated and sent in batches to NRSA. Training was given to shore station Managers, Fishermen Training Centres etc. for dissemination of PFZ through Radio, Telephone at Quilon and Quilandy.

INVESTIGATIONS ON ZOOPLANKTON COMPONENTS OF THE EEZ OF INDIA (FORV/SS/3)

K.J. Mathew, P.V. Rao, T.S. Naomi, N.G. Menon, K. Prabhakaran Nair, M.P. Molly, V.S. Kakati and M.M. Meiyappan

Studies on the distribution and ecology of various groups of zooplankton collected from the EEZ during the *FORV Sagar Sampada* cruises progressed at different centres of CMFRI and other Institutes namely, ZSI and NIO.

At CMFRI, Cochin, Amphipoda, cladocerans and lucifers were studied. Among amphipods, 16 genera have been identified and their length measurement was taken. Four species of *Lucifer* were identified from samples of ten cruises. Studies on size variation and sex ratio, seasonal and spatial abundance of species are progressing. In cladocera, the gross and standard length of parthenogentic females along with gross lengths of embryos were taken to ascertain the brood size. It was found that more than 85% of the population of *Penilia avirostris* was within the 50 m area. During the monsoon season high concentrations of *Penilia* and *Evadne* were seen in the 30 m depth zone off Cochin and 40 m depth zone off Karwar. Different size classes of cladocerans dominated in different regions.

The zooplankton groups studied by the scientists at the Regional Centre of NIO namely, mysids, ostracods, heteropods, hydromedusae and fish eggs and larvae progressed satisfactorily as reported by the scientists. A new species of mysis *Doxomysis andamanii* has been described. For the ostracods, the samples from cruises 9A, 10, 17, 18 and 24 are being studied. For the heteropods the samples under study are from cruises 11, 21, 22 and 24. As far as fish eggs and larvae are concerned the samples taken from the west coast during the cruises 12, 24, 28, 32, 37, 40 and 42 are being studied. The hydromedusae of the west coast collected during 1985-88 have been studied.

FISHERY OCEANOGRAPHY OF THE OFFSHORE REGIONS OF THE INDIAN EEZ (FORV/SS/1)

M.S. Rajagopalan, G. Subbaraju, V.N. Pillai, V.K. Pillai, C.P. Gopinathan, K.G. Girijavallabhan and S. Natarajan

Correlation of oceanographic characteristics with fish abundance using data collected on board FORV *Sagar Sampada* was attempted in regard to some commer-

cially important exploited/under exploited deep water fishes. Useful correlation was seen with threadfin bream, barracuda and bull's eye. Work on these lines is continued with respect to other commercially important deep water resources.

Resources Assessment of Seaweeds and Their Culture (FEM/SW/1)

V.S.K. Chennubhotla, N. Kaliaperumal

Studies were made on the seasonal variation in growth of carrageenan yielding red algae *Hypnea valentiae, Acanthophora spicifera,* and *Laurencia papillosa*, growing at Pudumadam and edible green algae, *Caulerpa racemosa, Ulva lactuca* and *Enteromorpha compressa* growing at Kilakkarai. These algae were collected once in a month from 6 to 10 of 0.5 m^2 randomly. The length measurement was taken only for red algae. Fresh and dry weight were taken for all the species. The dried samples were kept for analysis of carrageenan content from red algae and biochemical constituents from green algae. Data on environmental and hydrological parameters were collected from the study areas for correlating with the growth behaviour of these seaweeds.

The total quantity of seaweeds landed in Tamil Nadu during the period April to September 1994 was estimated as 2243 t (dry wt) constituting 2005 t of *Sargassum* spp., 5 t of *Turbinaria* spp., 119 t of *Gelidiella acerosa* and 114 t of *Gracilaria edulis*.

Breeding, Seed Production and Sea-Ranching of Sea-Cucumber *Holothuria Scabra* (FEM/CUL/2)

D.B. James

During the year *Holothuria atra* spawned on several occasions. The number of eggs released during October were 2.6 lakhs. The number of auricularia larvae produced varied from 12,000 to 1.62 lakhs. The length of the larvae varied from 240 to 483 μ. *Holothuria scabra* was subjected to thermal stimulation in October but there was no response from the animals in different occasions.

Conservation and Management of Coral Reefs (FEM/EE/1)

C.S.G. Pillai

During August, 1994 a resurvey of the fringing reef of Palk Bay was carried out to assess the biodiversity of corals. The prevailing environmental parameters were also monitored. It was observed that cage fishing for crabs caused significant damage to ramose corals since the fishermen broke many colonies while putting the crab traps.

During September 94, a resurvey of Krusadai Island was carried out. Intensive damage to corals and all associated organisms was observed. Overexploitation of algae and reef associated animals was going on. Copies of a detailed report were sent to Ministry of Environment and Forests, New Delhi, Minister of Fisheries,

Tamil Nadu, Director of Fisheries, Tamil Nadu and the Marine Park authorities of Gulf of Mannar emphasising the need for the conservation of the marine biological paradise.

Nearly forty colonies of reef corals belonging to 11 common species from Palk Bay near Mandapam were collected and transported underwater to the fish farm area. They were weighed, measured, tagged and transplanted at a site with a view to studying the growth and mortality rate. The sedimentation rate and the other physical parameters are being monitored. Some work on the corals of Minicoy atoll is also being carried out.

STUDIES ON EXPLOITATION OF AUXILIARY MARINE LIVING RESOURCES (FEM/AR/1)

P.A. Thomas and S. Jasmin

The exploitation and export of gorgonids from the south west coast of India was on the decline as the forest department imposed a ban on the export. The demand for the dried sea-horse from India is on the increase, and this trade is now widespread in Australia, Brazil, USA and New Zealand. The countries which are importing this commodity are Taiwan, Hong Kong, Korea and Japan.

During October-December, 3 samples of sponge collected from different parts of India have been analysed. These include the 'source material' collected by the team of Andhra University under a DOD project at Tuticorin, under an ICAR project.

Analysis of export data indicate that many auxillary resources of Indian origin are exported to foreign countries possibly for the extraction of 'wonder drugs'.

VII. Physiology, Nutrition and Pathology Division

Development, Evaluation and Farm Performance of Compounded Feeds for Prawns (PNP/35)

R. Paul Raj, M. Vijayakumaran, D.C.V. Easterson, D. Kandasami, Manpal Sridhar and P. Vijayagopal

Major constraints in feeds, feeding and culture practices in prawn farms of Nellore district of Andhra Pradesh were documented. Technical advice was given on selection of quality raw material, optimum processing of feed ingredients, optimum feeding strategies, water management and control of plankton blooms.

Studies were conducted on the physico-chemical characteristics, hydro-stability, digestibility of feeds and raw materials. Factors affecting feed intake and prawn production and feed efficiency in prawn farms were also investigated. The studies showed:

- Apparent FCR's ranged from 1.5:1 to 2.33:1

- No appreciable difference in apparent FCR's were observed when imported and indigenous feeds were compared.

- With imported feed costing Rs. 48,000 t the profit margins were very low.

- Stocking density of 60,000 to 70,000 PL/ha was optimum for the semi-intensive culture in the ponds owned by socially weaker farmers.

- Digestibility of certain feed ingredients viz. mantis shrimp meal and 40% incorporation of soya flour showed maximum digestibility.

- Optimum dietary protein to energy ratio ie., P/E ratio (mg protein/K cal) was found to be 108 for the juveniles of *P. indicus* (0.38 g - 0.48 g) with a protein requirement of 47% and gross energy (GE) of 442.28 K cal/100 g.

- Proximate composition of leather waste collected from tanneris of Tamil Nadu showed that the dried waste had a very low protein level (11.31%) and high ash content (41.7%). It is suspected that the chemicals used in the processing of leather may be detrimental to the prawns hence a thorough biological evaluation is necessary.

- Relative performance of three protein sources, prepared in the laboratory, viz. fish meal, clam meal and soyabean meal containing protein levels of 60%, 80% and 48% in the diets of *P. indicus* was evaluated. All these diets had 35% protein and FCR's of 1.5, 1.8 and 2.0 were recorded for fish meal diet, clam meal diet and soyabean meal diet respectively.

- Proximate composition of six feed samples collected from local farmers indicated a dry matter content of 70-93.29%, crude protein content of 25.56 to 50.52%, crude fat content of 2.5 to 6.46%, crude fibre content of 5.6 to 17.88%, ash content of 10.9 to 21.36%, acid insoluble ash content of 0.36 to 9.34% and nitrogen free extract content of 12.12 to 34.87%.

Endocrinological Factors Influencing Maturation in Penaeid Prawn *Penaeus Indicus* (PNP/39)

N. Sridhar and Mohan K. Zacharia

Accumulation of eyestalk, thoracic ganglion and brain were carried out from mature female *P. stylifera* and *P. indicus* samples. After processing these tissues extracts were prepared. The extracts were subjected to ultrafilteration procedure using a membrane of molecular weight cut off in the range of 500 and the volume of the extracts reduced to 1.5 to 2 ml. Protein concentration was estimated before and after ultrafilteration. Thoracic ganglion extracts contained higher percentage of protein compared to eyestalk and brain extracts inspite of the low quantity of tissue taken for preparation of extracts. A part of the extracts were subjected to horizontal slab gel electrophoresis. The protein pattern showed prominent bands both in eyestalk and thoracic ganglia extracts. Though protein was detected in the extracts of brain no band pattern was observed in both the cases.

Bioassay studies to induce gonadal maturation through injection of these extracts were initiated. Adult female *P. indicus* (size 125 mm, 15 g) were injected with 0.21 ml of the concentrated eyestalk extract when they reached pre-moult stage on alternate days for a week. The prawn in control group injected with crustacean saline moulted on the 4th day whereas the experimental group did not moult. This shows the inhibition of moulting due to the eyestalk extracts in the experimental animals. Experiments on this line with other extracts singly and in combination are in progress.

Identification of Genetic Stocks in Indian Mackerel *Rastrelliger Kanagurta* (PNP/41)

M.K. George, N.K. Verma and P.C. Thomas

Biochemical genetic profile of mackerel samples collected during mud-bank and post-mud-bank periods from Ambalapuzha were separately studied and compared. Allelic frequencies at 13 loci belonging to seven polymorphic enzyme systems did not differ significantly, indicating a homogenous genetic profile of the two populations.

Tolerance Limits of Certain Environmental Factors Affecting Physiological Behaviour of Some Cultivable Organisms (PNP/44)

M. Peer Mohamed, D.C.V. Easterson, D. Kandasami and N. Sridhar

Salinity and temperature tolerance in two bivalves viz., *Meretrix casta* and *Paphia malabarica* revealed that for the former species percentage weight gain served as a better indicator of tolerance.

100% survival was observed in salinities ranging from 15 to 35 ppt salinity and

a temperature of 25 ± 1°C. 30 ppt salinity indicated the highest weight gain. No clam survived at 45 ppt salinity. At 30 ± 1°C also 100% survival was found in 15-35 ppt salinity. Maximum weight gain of 3.31% was observed in the clams kept in 30 ppt salinity with no weight gain at 5 ppt salinity and a weight loss of 0.02% at 45 ppt salinity.

Thus, 30 ppt salinity and 30°C was found to be ideal in terms of physiological tolerance and growth performance for *Meretrix casta*.

In a similar experiment with *Paphia malabarica* 27 ± 1°C and 5 ppt salinity was found to be ideal.

Disease Investigations on Marine Fish and Shellfishes (PNP/46)

M. Vijayakumaran, R. Paul Raj, A.P. Lipton and N.K. Sanil

Successfully controlled disease problem caused by poor water quality and subsequent severe infestation of Zoothamnium all over the body of *P. monodon* in one of the extensive farms in Nellore. The control was effected by water exchange, feeding regulations and application of tea seed cake and zeolite. Good production of 1200 kg/ha was obtained from this farm at a stocking density of 40000/ha.

Poor growth and poor health condition in two small prawn farms in Nellore were detected to be due to feed wastage, high organic load and no water exchange. By initiating adequate protective measures like flushing and application of tea seed cake, the situation could be improved.

Two devastating diseases of bacterial or viral etiology were recorded in prawn farms of Nellore area in June-July and November-December 1994.

The cause of sudden mortality in two lobster holdings near Madras were traced to sudden decrease in salinity, increase in ammonia concentration, decrease in DO and poor handling during transportation. The problem could be tackled by designing appropriate biological filter, aeration and by proper quarantine of new arrivals.

Studies on Cryopreservation of Gametes and Embryos of Penaeid Prawn *Penaeus Indicus* (PNP/45)

A.D. Diwan and N. Sridhar

Cryopreservation trials at 0°C, -35°C and -190°C indicated that spermatozoa of *P. indicus* could be successfully cryopreserved for a period of two months and more. The percentage of reacted sperm after freeze thaw varied between 55 to 80 in glycerine mixed with DMSO, DMSO with trehalose, and DMSO and glycerine alone. Induction of egg activity was also studied in *P. indicus* in detail to assess the egg viability when cryopreserved.

GENETIC STUDIES ON MARINE PRAWNS (USIF IN-AES-780)

M.K. George, N.N. Pillai and N.K. Verma

Gel electrophoretic patterns of four polymorphic enzymes and morphometric measurements of population samples of *Penaeus indicus*, *P. monodon* and *P. semisulcatus* from selected regions were obtained and analysed. Zymograms showed species patterns. Interpopulation differences within each species were also measured by estimating the allelic frequency differences at about ten loci in *P. indicus*, five in *P. monodon* and four in *P. semisulcatus*. The frequencies were significantly different in populations of *P. indicus* from Cochin and Neendakara and between its east and west coast populations at one locus. Allelic frequencies of populations of *P. monodon* significantly differed at five loci belongting to ODH, AO and MDH enzymes. One locus of aldolase compared to Mangalore and Cochin populations of *P. semisulcatus* did not differ significantly. Mean values of certain morphometric measurements including tail weight in population samples of the three species showed significant differences between sexes and regions.

VIII. Socio-Economic Evaluation and Technology Transfer Division

Study on the Economic Performance of Trawlers (FE & E/24.1)

D.B.S. Sehara, K.K.P. Panikkar and R. Narayana Kumar

Analysis of data on cost and revenue collected from sample trawlers at Mangalore, Malpe and Karwar landing centres showed that the average catch of a trawler per trip was 720 kg at Mangalore, 660 kg at Malpe and 310 kg at Karwar and the average revenue per trip was Rs. 11,200, Rs. 19,400 and Rs. 11,900 respectively. The revenue received per trip at Malpe was comparatively higher than at the other two centres as the component of prawns and cuttle fish was more at Malpe.

The operating expenses per trip worked out to Rs.5612 at Mangalore, Rs. 6726 at Malpe and Rs. 6653 at Karwar. Wages formed about 47% of the operating expenses at Mangalore and Malpe, 43% at Karwar and, fuel accounted for 27%, 29% and 34% respectively. The percentage contribution of the remaining cost components varied from 3 to 10 of the operating expenses. The average net income per trip over operating cost was worked out at Rs. 5,588 at Mangalore, Rs. 12,764 at Malpe and Rs. 5,247 at Karwar.

Marine Fish Marketing in Tamil Nadu (FE & E/28)

R. Sathiadhas and R. Narayana Kumar

Data collection at different stages of marketing channels such as landing centres, wholesale and retail markets at Nagapattinam, Tuticorin and Kanyakumari has been completed.

Almost all the commercially important varieties of fish were found to have wide seasonal and regional variations in price, at all levels of transactions: in the Nagapattinam region, the average price of mackerel ranged from Rs. 15/kg at the landing centre to Rs. 21/kg at retail markets, whereas in Tuticorin, it ranged from Rs. 26 to Rs. 37 per kg. However day to day variations in producers' price of each variety at landing centre level were wider than the consumer price.

The analysis indicated that the fishermen's share in the consumer rupee ranged from 31 to 72 paise for different varieties and that the retailers were getting higher margins than wholesalers for almost all varieties of fish. Data on the marketing pattern of dry fish, pharmaceutically important varieties and on live fish trade showed that sea horses of four to six inch size fetched a value of Rs. 75 per piece and that the deep sea prawns and mackerel gained marketability in the interior markets like Madurai and Trichy. The project was completed and a detailed report is under preparation.

EXTENSION OF SEAWEED CULTURE PRACTICES TO FISHERMEN (FE & E/29)

Sheela Immanuel

Data collected on role performance, training needs, knowledge level and problems faced were analysed. Only 8% have fairly good level of knowledge. About 80% of the respondents know the preparation of edible seaweed recipes. All of them need financial and technical help to take up this technology. Nearly 45% of them need training on seaweed cultivation. The major problem reported by all the seaweed collectors is the physical strain involved in the job.

Under transfer of technology, a demonstration and a group meeting were conducted to 40 men and women in Seeniappa Dargha and Pamban areas respectively, on seaweed cultivation.

STUDY ON ADOPTION OF SHRIMP FARMING TECHNOLOGY IN SELECTED SHRIMP FARMS IN AND AROUND TUTICORIN (FE & E/30)

M.C. Arunmozhi Devi

Data collected from small, medium and large prawn farms in Tuticorin region were analysed. The stocking rate ranged from 1 to 2.5 lakh/ha in small and large farms. The average gross production was estimated at 765 kg/crop/ha for small farms and 2 to 3 tonnes/crop/ha for medium and large farms.

MODELLING AND EVALUATION OF EXTENSION STRATEGIES FOR THE DEVELOPMENT OF FISHING COMMUNITY (FE & E/31)

Krishna Srinath and R. Narayana Kumar

The fishing village of Chellanam was selected and the following models were demonstrated and evaluated.

1. Group farming approach in prawn farming:

This approach was demonstrated for the first time in the fisheries sector, in the South Chellanam *Padasekharam*, covering an area of 36 ha and 50 farmers. The procedure consisted of organising the farmers into a society (*Cherukida Sastreeya Chemmen Kootukrishisangham*) to coordinate the management of group farming at the village level, training of the farmers in scientific prawn farming and to demonstrate each of the farming practices in their fields.

The model largely proved to be effective as reported by 80% of the farmers and the economic benefits included increase in production and reduction in the cost of cultivation. Social gains included enhanced problem solving ability, better relationship within the family circles and fellow farmers, active participation of women and better attention to weaker farmers. 30% of the farmers followed the suggested practices with some variations.

Constraints experienced included stocking the farms at a time due to paucity of seed, cost of eradication and formulated feeds and long lease agreement period of 10-15 years stipulated by the financing institutions for issuing loans.

2. Women's Empowerment model:

The activities of the fisherwomen's group (*Matsyamahilavedi*) created earlier for this purpose were extended by creating three more units in different parts of the village. The first aquaculture project by women in India was launched in the village with the help of th BFFDA and the Kerala State Women's Development Corporation. Ten women successfully carried out prawn farming with the loan and grant assistance.

The prawn feed production units set up based on the low cost technology developed by the Institute was registered as All Women Small Scale Industry which produced and marketed 10 tonnes of 'Mahima Feed'.

The net making programme sponsored by the Central Social Welfare Board, was extended to 100 women. Thirty of them were given training in the techniques of net making with the help of CIFT.

The exercise book making unit sponsored by Kerala Khadi Board became operational.

Three women and two men were trained in mushroom cultivation at the KVK. Twenty five women peeling shed workers were given one day training in hygeine in fish processing by MPEDA.

A group discussion on 'Thrift' was organised for the members of the society in collaboration with the NABARD.

In order to identify the needs of the marine fishermen for planning extension programme a group discussion was held with them. Training in improved fishing techniques, development of infrastructure for storage of fish and utilisation of the fish discarded by the mechanised vessels were the important needs felt by them.

TRANSFER OF EDIBLE OYSTER AND PEARL CULTURE TECHNOLOGIES ALONG TAMIL NADU COAST (FE & E/32)

A. Reghunathan, R. Sathiadhas and Sheela Immanuel

The Muthupet lagoon in Thanjavur district of Tamilnadu was surveyed to assess the potential of carrying out edible oyster culture. The lagoon is 8 km away from the main road, occupying more than 1000 acres bordered with swampy stretch. Good quantity of edible oyster remains were found in the middle of the lagoon during the preliminary survey. Availability of seeds as well as adult edible oysters within the lagoon has been ascertained through benthic sampling.

Education programmes were organised as a preliminary part of transfer of technology. Instruments for data collection were developed and bench mark survey was initiated. Similarly, Villundithirtham area of Rameswaram was identified for organising demonstration on pearl culture technology.

वार्षिक रिपोर्ट का साराँश

मछली उत्पादन का आकलन

विदोहन की गई संपदाओं का अनुसंधान करने में, नियमित उपाय सुझाने में, समुद्री मात्स्यिकी विदोहन के बदलते प्रतिमान के अध्ययन में और विभिन्न उपयोक्ताओं जैसे सरकारी विभाग, उद्योग, उद्यमियों तथा अन्यों को डैटा प्रदान करने की दृष्टि में समुद्री मछली उत्पादन का आकलन सी एम एफ आर आइ का सबसे प्रमुख कार्य है। इस वर्ष के दौरान संस्थान द्वारा यह आकलन किया गया कि वर्ष 1994 के दौरान 2.28 मिलियन टन फिनफिश और कवचप्राणियों का अवतरण किया गया और यह वर्ष 1993 की अपेक्षा 80,000 टन ज़्यादा था। इस अवतरण का 86.5% यंत्रीकृत एककों का योगदान था और शेष कारीगरी यानों का। उत्तर-पश्चिम तट में अधिकतम अवतरण (36.4%) हुआ, जिसके बाद दक्षिण -पश्चिम तट (33.1%), दक्षिण-पूर्व तट (24.5%), उत्तर-पूर्व तट (4.6%) और लक्षद्वीप तथा आन्डमान व निकोबार द्वीप समूह (1.4%) आते हैं। देश के समुद्री मछली अवतरण की प्रमुख विशेषताएं ये हैं कि दक्षिण पश्चिम तट का अवतरण पिछले वर्ष के बराबर ही रहा। पश्चिम-पूर्व तट में 29.3% की घटती और दक्षिण पूर्व तट और उत्तर पश्चिम तट में क्रमश: 12.6% और 15.1% की वृद्धि हुई। तारली, श्वेत बेट और बांगडों के अवतरण में क्रमश: 49000, 12000 और 45000 टन की घटती हुई जबकि क्रॉकेर्स के अवतरण में 37000 टन, फीतामीन - 21,000, कारंजिड - 10,000, पेनिआइड झींगे- 51,000 और शीर्षपाद 17,000 टन की वृद्धि हुई।

समुद्री मात्स्यिकी अनुसंधान तथा प्रबंधन के स्टॉक निर्धारण तकनीक के अंदर जीवसंख्या में से पकड के नमूना बनाने की रूपरेखा बनाई गई है। मछली उत्पादन डैटा के सृजन, नवीकरण और सुधार के लिए सी-लैंगेज (C-Language) में कंप्यूटर सोफ्टवेयर विकसित किए गए हैं।

मात्स्यिकी एवं संपदा विशेषताओं का अध्ययन

मात्स्यिकी के प्रबंधन और अतिविदोहन किए गए स्टॉक के संरक्षण और परिरक्षण के संदर्भ में प्रग्रहण मात्स्यिकी पर अनुसंधान प्रमुख है। इसलिए इस पर निरंतर रूप से अध्ययन किया जाना आवश्यक है। प्रग्रहण मात्स्यिकी और विदोहन हुए स्टॉक से संबंधित अनुसंधान परियोजनाओं में विविध प्रकार की मछलियों की वहनीय पकड ही मुख्य विषय है।

वेलापवर्ती फिनफिश: पश्चिम तट के 4 और पूर्व तट के 3 केंद्रों में तारली मात्स्यिकी का अध्ययन किया गया। *सारडिनेला लौंगिसेप्स* का लंबाई रेंच 30-200 मि मी था और विशाखपट्टनम में यह आकार रेंच 30-100 मि मी था। मांगलूर-माल्प तट में इस जाति का अंडजनन काल जनवरी-मई था। पूर्व तट में जून-अगस्त के दौरान पकड हुई। दोनों तटों में लेसर सारडीनों के अंदर *एस. गिब्बोसा* सबसे प्रमुख जाति थी और इसका आकार रेंच 90-185 मि मी था। मांगलूर-माल्प क्षेत्र में अक्तूबर-मार्च के दौरान इस जाति का अंडजनन हुआ और टूटिकोरिन तट में अप्रैल-जून के दौरान। सबसे प्रमुख विशेषता यह थी कि पश्चिम तट में तारलियों का अवतरण 30% घट गया और पूर्व तट के केंद्रों में 240% बढ़ गया।

पश्चिम तट के 5 और पूर्व तट के 3 केंद्रों में भारतीय बांगडे का अध्ययन किया गया। विदोहन किए गए बांगडे का लंबाई रेंच 55-270 मि मी था। अंडजनन काल मांगलूर में अक्तूबर-मार्च, कोचीन में जनवरी-मार्च, विषिंजम में जनवरी-अप्रैल और अगस्त-सितंबर, मंडपम में अक्तूबर-मार्च और विशाखपट्टनम में अगस्त-मार्च था। पूर्व तट में अप्रैल-जुलाई और पश्चिम तट में फरवरी-सितंबर के दौरान पकड हुई।

विदोहन किए गए श्वेत बेटों की लंबाई का रेंच *स्टोलिफोरस डेविसी* 30-100 मि मी, *एस. बटाविएन्सिस* 40-109 मि मी और *एस. बुकानीरी* 30-119 मि मी के

क्रम में था। बंबई में 20-199 मि मी आकार वाले *कोइलिया डसुमेरी* को पकडा गया। कोचीन में मानसून के दौरान मात्स्यिकी का प्रमुख भाग *एस. माक्रोप्स* थे।

सीरफिश मात्स्यिकी का श्रृंगकाल वेरावल में जनवरी, कोचीन में अगस्त और टूटिकोरिन और मद्रास में जुलाई था। मात्स्यिकी में *स्कोम्बरोमोरस कमेर्सन* और *एस. गट्टाटस* का प्रमुख योगदान हुआ। *एस. कमेर्सन* के 68 से मी से कम आकार वाली मछलियों को ट्राल तथा कोष संपाश द्वारा और 36-112 से मी आकार रेंच की मछलियों को ड्रिफ्ट जाल तथा कांटा डोर द्वारा पकडा जाता है। मांगलूर, कोचीन और टूटिकोरिन में इस जाति की 34 से मी से कम आकार वाली मछलियों को पोडि वला / वलय संपाश / ट्राल द्वारा बडी मात्रा में पकडा गया। ट्यूनाओं की पकड का 50% ड्रिफ्ट गिल जाल द्वारा हुआ। वर्ष के दौरान ट्यूनाओं की पकड में 20% की वृद्धि हुई। फिरभी वेरावल, कोचीन, बंबई और टूटिकोरिन में पकड में घटती अंकित की गई। ट्यूनाओं पर किए गए अनुसंधानों से यह व्यक्त होता है कि मांगलूर-माल्प क्षेत्र में ड्रिफ्ट गिल जाल प्रयास द्वारा *ई. एफिनिस* का अवतरण बढाया जा सकता है और टूटिकोरिन में *ई. एफिनिस* तथा *ए. थासार्ड* का भी जहाँ इन दोनों का भारी मत्स्यन दबाव है।

लक्षद्वीप क्षेत्र से ट्यूना लाइव बेट का विदोहन 100 टन था। इन मछलियों का मानक आकार रेंच 14.6 से 78.6 मि मी था। *स्प्राटलोइड्स डेलिकाटिलस* का लंबा अंडजनन काल व्यक्त किया गया और नवंबर-दिसंबर श्रृंगकाल था।

महाराष्ट्र तथा गुजरात तटों में बंबिलों के अवतरण में पर्याप्त वृद्धि दिखाई पडी। विदोहन की गई मछलियों का लंबाई रेंच महाराष्ट्र में 30-500 मि मी और गुजरात में 15-395 मि मी था। गुजरात में इसके दो अंडजनन काल अंकित किए गए। फीतामीनों की मात्स्यिकी में पूरे भारतीय तट में *ट्राइक्यूरस लेप्ट्यूरस* प्रचुर मात्रा में दिखाई पडी। इस मात्स्यिकी का श्रृंग काल पूर्व मानसून मौसम था। विभिन्न केंद्रों में अप्रैल-नवंबर के दौरान मत्स्यन कार्य हुआ।

तलमज्जी फिनफिश: पश्चिम तट के दो और पूर्व तट के तीन केंद्रों में उपास्थिमीन संपदाओं का अनुसंधान किया गया। बंबई में कुल उपास्थिमीन पकड का 72% सुराएं थे और *स्कोलियोडोन लैटिकॉडस* मुख्य जाति थी। आकार रेंच में पुरुष और स्त्री जातियों में अंतर दिखाया पडा। टूटिकोरिन में उपास्थिमीनों का 80% ट्रालरों का योगदान था। गभीर सागर ट्रोलरों द्वारा उपास्थिमीन पकड के 100% सुराओं तथा प्रिंप ट्रालरों द्वारा 79% रे का अवतरण किया गया। कोचीन में ड्रिफ्ट गिल जाल और कांटा डोर अवतरण में *राइसोप्रिओनोडोन एक्यूटस* और ट्राल अवतरण में *डासिआटिस* जाति प्रमुख दिखाई पडी। मद्रास में पिछले वर्ष की अपेक्षा उपास्थिमीन की पकड में घटती हुई। कुल उपास्थिमीन पकड का 97% ट्रालरों का योगदान था।

इस वर्ष पर्चों की मात्स्यिकी में घटती अंकित की गई। ट्रालरों, कांटा डोर तथा गिल जाल द्वारा विदोहन संपन्न हुआ। केरल तटों में दिसंबर-मार्च और मान्नार खाडी में मई-अक्तूबर मात्स्यिकी का श्रृंग काल था। कोचीन में *एपिनिफेलस डयाकांतस, प्रिस्टिपोमोइड्स टाइपस* और *एपिनिफेलस क्लोरोस्टिग्मा* पकड की प्रमुख जातियाँ थी। विषिंजम और टूटिकोरिन में *लेथरिनस नेब्यूलोसस* और मद्रास में *एपिनिफेलस टॉविना* मुख्य जातियाँ थी।

बंबई में शिंगटियों की मात्स्यिकी में *ओस्टिओजेनीसस मिलिटारिस* और *टैकिस्यूरस डसुमेरी* मुख्य जातियाँ थी जिनका श्रृंग काल दिसंबर था। कोचीन में ट्रालरों तथा ड्रिफ्ट जालों द्वारा मत्स्यन में घटती देखी गई और *टी. थालासिनस* का अधिक मत्स्यन हुआ। मद्रास में कांटा डोर द्वारा *टी. डसुमेरी* और विशाखपट्टनम में *टी. थालासिनस* प्रमुख जातियाँ थी।

कोचीन में सूत्रपख ब्रीम का अधिकतम अवतरण हुआ, इसके बाद मद्रास, बंबई, मांगलूर, टूटिकोरिन और वेरावल आते हैं। वेरावल तथा मांगलूर के अलावा सारे केंद्रों में इसके अवतरण में पर्याप्त वृद्धि अंकित की गई। वेरावल, मांगलूर, माल्प और काकिनाडा में नेमीप्टीरस जापोनिकस, बंबई तथा विशाखपट्टनम में *एन. मीसोप्रिओन* तथा टूटिकोरिन में *एन. डिलाग* पकड की प्रमुख जातियाँ थी।

मुल्लनों का बडी मात्रा में अवतरण मंडपम क्षेत्र में हुआ। सारे केंद्रों में *लिओग्नाथस बिंडस* और *सेक्यूटर इंसिडियाटर* प्रमुख अवतरण था। इसके अतिरिक्त मद्रास, काकिनाडा और विशाखपट्टणम में *एल. बिन्डस*, मांगलूर तथा माल्प में *एस. इंसिडियाटर*, कारवार, ताद्री और टूटिकोरिन में *गस्सा माइन्यूटा*, मंडपम क्षेत्र में *लिओग्नाथस डसुमेरी* और *एल. जोनीसी* और टूटिकोरिन में *एल. डसुमेरी* अवतरण की मुख्य जातियाँ थी।

क्रॉकेर्स का अवतरण वेरावल, काकिनाडा, विशाखपट्टणम और कालिकट में कम हो गया और बंबई तथा मद्रास में अधिक हो गया। अधिकांश पकड ट्रालरों द्वारा हुई। मद्रास में *ओटोलिथस रूबर*, कालिकट में *जोनिअस सिना* और *ओटोलिथस रूबर* प्रमुख जातियाँ थी। बंबई, कोचीन, कालिकट, बेपूर, मद्रास और विशाखपट्टणम में तुम्बिलों के अवतरण में वृद्धि और वेरावल में घटती दिखाई पडी।

चपटी मछलियों के कुल अवतरण का 95% पश्चिम तट याने मांगलूर-कोचीन क्षेत्र से प्राप्त हुआ। मांगलूर और माल्प में मानसूनोत्तर अवधि के दौरान ट्रालरों द्वारा चपटी मछलियों का भारी अवतरण हुआ।

गोट फिश का अवतरण पूर्व तट में अधिक और पश्चिम तट में कम था। परिपक्व तथा अंडरिक्त मछलियाँ दिसंबर-जनवरी के दौरान बडे पैमाने में प्राप्त हुई। श्वेत-मछली का अधिकतम अवतरण नवंबर-दिसंबर में था।

कर्नाटक क्षेत्र में स्टोमाटोपोड्स, कर्कट, गास्ट्रोपोड्स, द्विकपाटियाँ, एकिनोडेर्म्स आदि नितलस्थ जीवों को प्राप्त हुआ और इन्हें निकाल दिया।

क्रस्टेशियन कवचप्राणी: इस वर्ष के दौरान हुए अधिकतम झींगा उत्पादन का 73% पेनिआइड झींगे और 27% नॉन पेनिआइड थे। अधिकांश केंद्रों में पेनिआइड झींगों के अवतरण में वृद्धि हुई। केरल के कोचीन में मानसून के दौरान 80,000 टन *पैरापेनिओप्सिस स्टाइलिफेरा* का अवतरण हुआ। भारत के पश्चिम तट में गहरे जल में अति मत्स्यन के कारण झींगा संपदा की कुल अपरंपरागत जातियों को भी प्राप्त हुआ। गुजरात में महाचिंगट का अवतरण अधिक मात्रा में हुआ और इसके बाद तमिलनाडु, केरल और महाराष्ट्र में भी इस जाति का अवतरण हुआ। वेरावल और मद्रास में *थन्नस ओरिएन्टालिस*, बंबई में *पैन्यूलिरस पोलिफैगस* और कालिकट में *पी. होमारस* का अवतरण हुआ। देश की कर्कट मात्स्यिकी का मुख्य भाग तमिलनाडु, गुजरात और केरल से प्राप्त हुआ। बंबई, मांगलूर, कोचीन तथा शक्तिकुलंगरा में गहरे जल के मत्स्यन द्वारा इस मात्स्यिकी की *कैरिब्डिस क्रूसिएटा* जाति को अधिक मात्रा में प्राप्त हुआ।

मोलस्क कवचप्राणी: इस वर्ष 1 लाख टन शीर्षपादों का अवतरण हुआ जो पिछले वर्ष की अपेक्षा 13,000 टन अधिक था। इस मात्स्यिकी में *सेपिआ फरोनिस, एस. एक्यूलेटा* और *लोलिगो* डुआसेली शामिल थे।

मलबार तट की हरित शंबू की मात्स्यिकी में इस वर्ष घटती की प्रवणता दिखाई पडी। काकिनाडा उपसागर में 1200 टन सीपी का उत्पादन हुआ। कंडलेरु ज्वारनदमुखी से 1048 टन खाद्य शुक्ति के स्टॉक का आकलन किया गया। प्राकृतिक संस्तरों से अतिमत्स्यन और छोटी सीपियों के मत्स्यन के कारण नेट्टूर, चेप्पनम और कुम्बलंगी में काली सीपी *विल्लोरिटा साइप्रिनोइड्स* का मत्स्यन बहुत कम था।

मंडपम में पहले छोडे गए 3 प्रशंखों को 1127-1209 दिनों बाद पुन:प्राप्त हुआ। टूटिकोरिन में 3,40,000 प्रशंखों का अवतरण हुआ।

मात्स्यिकी पर्यावरण का मॉनीटरन

कोचीन, विशाखपट्टणम, मंडपम, मद्रास, विषिंजम, कालिकट, मिनिकोय, कारवार, मांगलूर, बंबई, काकिनाडा तथा टूटिकोरिन में जल की विभिन्न विशेषताओं का मॉनीटरन किया गया। विशाखपट्टणम में अप्रैल से अगस्त तक सामान्य उत्प्रवाह हुआ। दक्षिण-पश्चिम तट में उपरितल का तापमान विषिंजम में 24.3°C से 25.2°C और कोचीन में 25.7°C से 30.4°C अंकित किया। विशाखपट्टणम, काकिनाडा, टूटिकोरिन तथा मद्रास में भी तापमान विभिन्न रेंच में अंकित किया।

कोचीन में अप्रैल में *कीटोसिरस* जाति की फुल्लिकाओं (blooms) की उपस्थिति दिखाई पडी।

तटीय मेखला की पर्यावरण पारिस्थितिकी का अध्ययन यह संकेत करता है कि चंद्रगिरी तथा नीलेश्वर के आसपास की ज्वारनदमुखियों में उत्पादनक्षमता कम है।

कोचीन के कुम्बलंगी-पेरुम्पटप्पू पश्चजलों में जुलाई '94 के दौरान दिखाए पडे जीवों, जो मछलियों को बडे पैमाने में खाते हैं, पर अध्ययन चलाया गया। जाल में पड जाने वाले झींगा, मछली, मछली बेट को खाने वाले इस जीव को मलयालम में अरिप्पन कहा जाता है। इस अवधि के दौरान विभिन्न स्थानों से प्रति वर्ग मीटर से 1200 से 1.2 लाख जीव दिखाए पडे। इस की उपस्थिति का कारण ज्वारीय जल का प्रवाह ठीक तरह नहीं होना और ज्वारनदमुखी के द्वार में मिट्टी का जमाव होना है।

कोचीन में 20 मी जल की गहराई में मई महीने के दौरान आसपास के फैक्टरियों से निकाले जाने वाले अमोणिया और इनओर्गानिक फोसफेट की उपस्थिति अंकित की गई। तलछट में अप्रैल महीने के दौरान लेड का स्तर अधिक दिखाया पडा। कारवार के कुछ झींगों से संग्रहित शुक्तियों में मेरक्यूरी का स्तर शुद्ध जल की शुक्तियों की अपेक्षा अधिक देखा गया इसका कारण फैक्टरियों से निकाली जाने वाली मेरक्यूरी जल में फैल जाना है। टूटिकोरिन में तलछट में जल में फ्लाइ एश के अंश पर अध्ययन जारी रखा।

समुद्री शैवाल तथा इसके संवर्धन पर किए गए अध्ययनों द्वारा यह आकलित किया गया कि तमिलनाडू से अप्रैल-दिसंबर '94 के दौरान 2005 टन *सरगैसम*, 5 टन *टरबिनेरिया*, 119 टन *जेलीडियेल्ला एकरोसा* और 114 टन *ग्रैसिलेरिया इडुलिस* का विदोहन किया गया। कैरागिनन, लाल शैवाल तथा खाद्य हरित शैवाल के मौसमिक परिवर्तनों पर अध्ययन जारी रखा।

प्रवाल भित्तियों का परिरक्षण तथा प्रबंधन कार्यक्रम के अंदर पाक खाडी के तटीय प्रवाल भित्तियों पर सर्वेक्षण किया गया। इससे यह देखा गया कि कर्कटों के मत्स्यन करने पर प्रवाल भित्तियों की शाखाओं पर क्षति होती है। कूसदी द्वीप की मान्नार खाडी में प्रवालों का अत्यधिक नाश होता है। इस पर और इस क्षेत्र के शैवालों तथा प्रावल मछलियों के अधिक विदोहन पर एक विस्तृत रिपोर्ट भारत सरकार तथा तमिलनाडू सरकार को प्रस्तुत की गई है। गौण समुद्री जीव संपदाओं पर चलाए अध्ययन से व्यक्त हो गया कि भारत के दक्षिण पश्चिम भाग में गोरगोनिडों के निर्यात पर किए गए रोक के कारण इनके विदोहन तथा निर्यात में घटती देखी गई है।

दूर संवेदन तथा शक्य मत्स्यन मेखला

दूर संवेदन कार्यक्रम के अंदर एन आर एस ए से प्राप्त शक्य मत्स्यन मेखला के आंकडे/नक्शे मछुआ संघ, फेडरेशन, मत्स्यफेड और अन्यों को उनकी उपयोगिता के लिए दिए गए। तटीय क्षेत्र के स्टेशन प्रबंधकों और मछुओं को रेडियो तथा टेलिफोन द्वारा कोयलोन से कोयलांडी तक आंकडों के प्रसारण पर प्रशिक्षण दिया गया।

अनन्य आर्थिक मेखला की संपदाओं का सर्वेक्षण

एफ ओ आर वी *सागर संपदा* के समुद्री पर्यटनों में संस्थान ने भाग लिया और अनन्य आर्थिक मेखला से संग्रहित नमूनों का सर्वेक्षण किया गया। ऐंफीपोड में 16 वंश पहचाने गए और उनकी लंबाई का आंकडा लिया गया। 10 पर्यटनों से प्राप्त नमूनों से *लूसिफर* की 4 जातियों को पहचान गया। 50 मी क्षेत्र से क्लैडोसीरा की *पैनिलिआ एविरोस्ट्रिस* जाति बडी मात्रा में देखी गई। मानसून के दौरान कोचीन में 30 मी और कारवार में 40 मी गहराई से *पैनिलिआ* और *इवाडने* की भारी उपस्थिति दिखाई पडी।

चुनी गई वाणिज्यिक प्रमुख जातियों की प्रचुरता और महासागरीय आंकडों के सहसंबंध का अध्ययन किया गया।

समुद्री संवर्धन तकनोलजी

समुद्री प्रग्रहण की घटती और समुद्री भोज्य की बढ़ती आवश्यकता और समुद्री उत्पादों का निर्यात बढ़ाने की ज़रूरत के संदर्भ में समुद्री संवर्धन की तकनोलजियाँ

विकसित करना आवश्यक है। इस दिशा में वर्ष के दौरान संस्थान द्वारा प्रगतिपूर्व अनुसंधान किए जा रहे है।

पेनिआइड झींगों का प्रेरित परिपक्वन: मंडपम में *पेनिअस सेमीसुल्कैटस* के प्रेरित परिपक्वन, अंडजनन और स्फुटन में सफलता प्राप्ति के पश्चात *पी. इंडिकस* में भी ऐसा अनुसंधान करके सफल परिणाम निकला। नेत्र वृंत अपक्षरण करने के अलावा पी एच, लवणता, प्रकाश तीव्रता और खाद्य के नियंत्रण द्वारा *पी. इंडिकस* का अंडजनन किया जा सकता है। यह भी देखा गया कि *पी. इंडिकस* को 250–300 दिनों में परिपक्व बनाकार 21–28 बार अंडजनन कराया जा सकता है और इस प्रक्रिया द्वारा 1.7–1.8 लाख नोप्लियों को निकाला जा सकता है।

कृत्रिम वीर्यसेचन (insemination) द्वारा *पी. मोनोडोन* ने वीर्यसेचन के 5 दिनों बाद अंडजनन किया और 2.9 लाख नोप्लियों को छोडा। इसी झींगे ने 4 दिनों बाद फिर से अंडजनन किया।

द्विकपाटियों का संवर्धन: *पिंक्टैडा फ्यूकेटा* के प्रेरित अंडजनन की सफलता के परिणाम स्वरूप इस जाति से 2,11,300 अंडों का उत्पादन किया गया जिनमें से 76,300 को वालिनोक्कम उपसागर में स्थानांतरित किया गया। इसके बाद के अंडजनन में उत्पादित 1.3 लाख स्पैटों में से 13,000 को 1,300/– रुपए की दर में गुजरात राज्य मात्स्यिकी विभाग को बेच दिया।

क्रासोस्ट्रिआ माड्रासेंसिस के प्रजनन एवं स्पैट उत्पादन द्वारा लगभग 8 लाख स्पैटों का उत्पादन किया गया। 6 अवसरों में *पैफिआ मलबारिका* का सफलता पूर्वक अंडजनन किया गया। इस अध्ययन के लिए प्रौढ सीपियों को केरल के अष्टमुडी से टूटिकोरिन में लाया गया। कुल उत्पादन में से 45,000 स्पैटों को टूटिकोरिन उपसागर के लर्सरी में स्थानांतरित किया गया। *मेरेट्रिक्स मेरेट्रिक्स* का अंडजनन किए जाने पर भी पूरे स्पैटों की मृत्यु हुई। कालिकट में हरित शंबु का प्रयोगशाला में प्रेरित प्रजनन किया गया और डिंभकों को नेत्र की बढती तक पालन किया जा सका। खाद्य शुक्ति तथा मुक्ता शुक्ति के स्पैटों को टूटिकोरिन की स्फुटनशाला से लाकर उनका प्रतिरोपण मुल्की, धर्मडम, कोरपुष़ा, कारवार, मांगलूर, कालिकट और कोचीन की ज्वारनदमुखियों में किया गया।

कालिकट तथा कोचीन में प्रतिरोपित मुक्ता शुक्तियों, जिनमें केंद्रक अंतर्रोपित किया गया है, की सामान्य अतिजीवितता और बढ़ती आंकी गई। कोचीन के अंधकारनष़ी में 33% मुक्ता उत्पादन हुआ।

प्रजनन एवं समुद्र रैंचन: दलवपुरम के अष्टमुडी झील में *पैफिआ मलबारिका* के 54,500 बीजों का समुद्र रैंचन किया गया और इनमें से पुन:प्राप्ति 8% थी।

स्फुटनशाला में पालित एवं खेत में बढ़ाए गए *पी. सेमीसुल्कैटस* और *पी. मलबारिका* को टैगन करके पाक उपसागर में छोडा गया। *पी. सेमीसुलकैटस* को 80 दिनों बाद और *पी. इंडिकस* को 27 दिनों बाद पुन:प्राप्त हुआ।

परीक्षणों से यह व्यक्त हो गया है कि समुद्री ककड़ी (*होलोथूरिया अट्रा*) कई बार अंडजनन करता है। लेकिन *एच. स्काब्रा* ने तापीय उद्दीपन करने पर भी अंडजनन नहीं किया।

समुद्री संवर्धन तकनोलजियों का सुधार

सी एम एफ आर आइ शरीरक्रिया विज्ञान, जननात्मक शरीरक्रिया विज्ञान, एन्डोक्राइनोलजी, पोषण, गैमीटों का हिमशीतीकरण, आनुवंशिकी तथा बयो तकनोलजी में अनुसंधान आयोजित करके समुद्री संवर्धन की तकनोलजियों में सुधार लाने के प्रयास में है।

आंध्र प्रदेश में किए जाने वाले झींगा संवर्धन में मिश्रित खाद्य देने से यह व्यक्त हो गया कि देशज और आयात खाद्यों में कहने लायक विशेषता नहीं है। कोचीन में किए गए परीक्षणों से यह दिखाया पडा कि खाद्य बनाते वक्त 80% मैंटिस चिंगट और 40% सोया चूर्ण जोड देना अत्यंत उचित होगा। मद्रास में किए गए परीक्षणों से मालूम हो गया कि चमडा के अवशिष्ट में रासायनिक वस्तुएं होने के कारण झींगा खाद्य के लिए इसका उपयोग करना उचित नहीं होगा। दो द्विकपाटियों में किए गए तापमान एवं लवणता सह्यता परीक्षणों से यह दिखाया पडा कि *मेरेट्रिक्स कास्टा* में भार की वृद्धि तीव्र गति से हो जाती है। अन्य

जातियों में लवणता सह्यता 15 ppt - 35 ppt थी और भार की अधिकतम वृद्धि 30 ppt लवणता में हुई थी। 25±1°C से 30±1°C के बीच के तापमान में 100% अतिजीवितता दिखाई पडी। इस तरह संवर्धन करने लायक अच्छी जाति *पी. मलबारिका* है जो 27±1°C तापमान और 5 ppt लवणता में जी सकती है।

0°C, -35°C और -190°C में किए गए हिमशीतीकरण परीक्षणों द्वारा यह व्यक्त हो गया कि *पी. इंडिकस* का स्पेर्माटोज़ोआ दो महीने तक जी सकता है।

नेल्लूर के गहन चिंगट खेत में जूतनाम्रियम के संक्रमण से *पी. मोनोडोन* में दिखाये पडे रोग का नियंत्रण जल का परिवर्तन, खाद्य नियमन तथा ज़िओलाइट प्रदान करने से किया गया। जल की कम गुणता के कारण यह रोग हुआ।

मद्रास के एक फार्म में लवणता की तुरंत घटती, अमोणिया की सांद्रता की बढ़ती, विलीन ऑक्सिजन की कमी और ठीक तरह की परिवहन व्यवस्था नहीं होने के कारण महा चिंगट की मृत्यु संख्या अधिक देखी गई।

भारतीय बांगडे के आनुवंशिक संग्रहण के अध्ययन से व्यक्त हो गया कि केरल के अंबलपुषा से प्राप्त नमूनों में समांग आनुवंशिक प्रोफइल दिखाया पडा।

अंत:स्राव विज्ञान के क्षेत्र में *पेनिअस इंडिकस* और *पी. स्टाइलिफेरा* के नेत्रवृंत, वक्षीय गुच्छिका और मस्तिष्क पर अध्ययन चलाए गए। नेत्रवृंत का सारसत्त (extract) *पी. इंडिकस* की प्रौढ मादा में टीका लगाने पर इसके निर्मोचन में देरी दिखाई पडी।

मात्स्यिकी अर्थशास्त्र पर अध्ययन

मात्स्यिकी एक आर्थिक प्रक्रिया होने के अतिरिक्त जीवसंख्या के लिए एक प्रोटीन युक्त खाद्य भी है। बारंबार मत्स्यन के कारण संपदाएं कम हो जाने के समय मात्स्यिकी अर्थशास्त्र पर अध्ययन करना अत्यंत आवश्यक है। इस उद्देश्य से संस्थान द्वारा मत्स्यन परिचालन की आर्थिकी पर अध्ययन शुरु किया गया है। इसके अनुसार मांगलूर में औसत आय 5,588 रु, माल्प में 12,764 रु और कारवार में 5,247 रु आंका गया।

नागपट्टणम, टूटिकोरिन और कन्याकुमारी के चुने गए केंद्रों में समुद्री मात्स्यिकी विपणन पर अध्ययन चलाए गए। इन अध्ययनों द्वारा व्यक्त हो गया कि (1) भिन्न भिन्न किस्म की मछलियों के लिए मछुओं को मिलने वाला शेयर 31 से 72 पैसे तक बढ गया, (2) अधिकांश किस्म की मछलियों के विपणन का लाभ थोक व्यापारियों की अपेक्षा फुटकर व्यापारियों को मिलता है, और (3) मदुरै तथा ट्रिच्ची जैसे आंतरिक बाज़ारों में बांगडा और गहरे सागर के झींगों के लिए अच्छा दाम मिल गया।

तकनोलजियों का स्थानांतरण

उत्पादन एवं रोज़गार के क्षेत्र में तकनोलजी के स्थानांतरण की प्रधानता मानते हुए संस्थान ने विस्तार एवं तकनोलजी के स्थानांतरण की कार्यविधियाँ और भी प्रबल कर दी है। मंडपम क्षेत्र में समुद्री शैवाल पर किए गए अध्ययन द्वारा यह व्यक्त हो गया कि अधिकांश मछुओं, जिन्हें समुद्री शैवाल के तरकीब तैयार करना मालूम है, को इस संवर्धन के बारे में प्रशिक्षण की ज़रूरत है, मंडपम के पास के एक गाँव में समुद्री शैवाल संवर्धन पर एक प्रदर्शनी एवं बैठक आयोजित की गई।

टूटिकोरिन के पास किए गए चिंगट कृषि की तकनोलजी के अध्ययन से मालूम पडा कि इस के खेतों की संग्रहण दर प्रति हेक्टयर 1 से 2.5 लाख/झींगें हैं। कोचीन के चेल्लानम गाँव में किसानों की सहकारिता से मिश्रित कृषि की प्रदर्शनी की गई और यह तरीका सभी दृष्टि से अत्यंत फलप्रद देखा गया।

महिला प्रबलीकरण कार्यक्रम के अंदर गाँव के विभिन्न भागों में 'मत्स्य महिला वेदी' के 3 एककों की स्थापना की गई। इसके अंदर महिलाओं द्वारा संस्थान में विकसित कम लागत की तकनोलजी के आधार पर 10 टन 'महिमा' खाद्य उत्पादित किया गया और महिलाओं को जाल के निर्माण में प्रशिक्षण भी दिया गया।

खाद्य शुक्ति एवं मुक्ता संवर्धन तकनोलजियों के अंदर तमिलनाडू के मुत्तुपेट लैगून का सर्वेक्षण किया गया

और इस क्षेत्र की प्रौढ़ खाद्य शुक्तियों एवं बीजों की उपलब्धि पर अध्ययन करके तकनोलजी स्थानांतरण के भाग के रूप में इस पर शिक्षा कार्यक्रम आयोजित किया गया।

प्रशिक्षण एवं शिक्षा कार्यविधियाँ

पिछले वर्षों की तरह कृषि विज्ञान केंद्र (के वी के), प्रशिक्षक प्रशिक्षण केंद्र (टी टी सी) तथा समुद्री संवर्धन में स्नातकोत्तर कार्यक्रम (पी जी पी एम) द्वारा प्रशिक्षण और शिक्षा कार्यविधियों में सी एम एफ आर आइ ने अत्यंत महत्वपूर्ण स्थान निभाया। पी जी पी एम के अंदर एम. एस सी के दो सत्र और पी एच.डी का एक सत्र पूरा हो गया। एम.एस सी 1993-96 सत्र का डेफिश्यन्सी कोर्स एवं प्रथम सेमेस्टर पूरा हो गया। एम. एस सी 1994-97 के सत्र की दाखिला अक्तूबर '94 में हुई और डेफिश्यन्सी कोर्स चल रहा है। पी एच.डी कार्यक्रम के अंदर 7 अध्येताओं को विज्ञान और तकनोलजी का कोचीन विश्वविद्यालय द्वारा डॉक्टरी डिग्री प्रदान की गई। 1994-97 सत्र के 4 छात्रों ने प्रथम सेमेस्टर पूरा कर लिया।

टी टी सी द्वारा समुद्री संवर्धन और स्कूबा डाइविंग में कुल 42 कर्मचारियों को प्रशिक्षण दिया गया।

संस्थान के के वी के द्वारा 'प्रयोगशाला से खेत तक' कार्यक्रम आयोजित किया गया और अनुसूचित जाति और जनजाति के 56 कुटुंबों को विभिन्न क्षेत्रों में प्रशिक्षण दिया गया।

अनुसंधान और विकास में सहायता एवं परामर्श

वर्ष के दौरान संस्थान की निपुणता की उपयोगिता करने के उद्देश्य से उद्यमियों, सरकारी एवं निजी एजेंसियों को परामर्श सेवा दी गई। इसके अतिरिक्त समुद्री प्रग्रहण एवं मात्स्यिकी संवर्धन के विभिन्न पहलुओं पर भी परामर्श सेवा प्रदान की गई।

पेनिआइड झींगा स्फुटनशाला के परामर्श के अंदर आंध्र प्रदेश के चिरला के एक निजी उद्यमी के लिए 40 मिलियन बीजों की क्षमता वाली एक स्फुटनशाला की रूपकल्पना की गई। इसका निर्माण कार्य पूर्ण हो गया। पादपप्लवकों का संवर्धन और पुन: परिवपक्वन की सुविधाओं की जांच की गई।

अन्य कार्यक्रमों के अंदर, विल्लिंग्डन द्वीप के उद्धार परियोजना के लिए पोताश्रय क्षेत्र में निकर्षण (dredging) का प्रभाव निर्धारित करने के लिए कोचीन पत्तन न्यास को परामर्श दिया गया।

अन्य कार्यक्रम के अंदर संस्थान ने जनवरी, 1995 के दौरान आई एस आर ओ के लिए केरल के एरनाकुलम और त्रिश्शूर के चुने गए क्षेत्रों में समाज-आर्थिक सर्वेक्षण आयोजित करने के लिए परामर्श दिया।

अनुसंधान परिणामों का प्रकाशन

पिछले वर्षों के समान संस्थान में किए गए अनुसंधान कार्यों के परिणाम राष्ट्रीय एवं अंतर्राष्ट्रीय वैज्ञानिक पत्रिकाओं और परिचर्चाओं/कार्यशालाओं/सम्मेलनों के कार्यवृत्तों में प्रकाशित किए गए। इसके अतिरिक्त 1994-95 के दौरान संस्थान के निम्नलिखित प्रकाशन जारी किए गए:

1. समुद्री मात्स्यिकी सूचना सेवा, तकनीकी व विस्तार सेवा सं. 127-135
2. सी एम एफ आर आइ न्यूज़लेटर सं. 61-64
3. सी एम एफ आर आइ अनुसंधान मुख्य अंश 1993-94
4. सी एम एफ आर आइ वार्षिक रिपोर्ट 1993-94
5. भारत में पेर्च मात्स्यिकी - सी एम एफ आर आइ बुलेटिन 47
6. चिंगट खाद्य का सूत्रीकरण और खाद्य प्रबंधन - सी एम एफ आर आइ विशेष प्रकाशन सं. 60

इस प्रकार संस्थान समुद्री फिनफिश और कवचप्राणी संपादाओं, प्रशिक्षण व शिक्षा कार्यक्रम, समाज-आर्थिक अध्ययन और सहकारी कार्यक्रमों में अनुसंधान कार्य जारी किए और भारत के समुद्री मछली उत्पादन की समस्याएं तथा उत्पादन का आवर्धन करने का प्रयास किया।

OUR RESEARCH PAPERS*

BENSAM, P. 1994. An overview on the present status and future prospects, of demersal fin fish resources in India. *Indian J. Fish* 39 (1,2) 104-110 (1992)

BENSAM, P. AND N.G. MENON 1994. The endangered, vulnerable and rare demersal marine fin fishes of India. In: P.V. Dehadrai, P. Das and S.R. Varma (eds) *Threatened Fishes of India* Natcon Publ. 4 : 297-305

BENSAM, P., N.G. MENON, K. BALACHANDRAN AND J. ANDREWS 1994. Need for protecting the nonedible benthic biota of the inshore waters for the benefit of the coastal resources and the fishing industry. *Mar. Fish. Infor. Serv., T&E Ser.*, 128 : 1-5

BENSAM, P. AND T.P. UDHAYASHANKAR 1994. Colonisation and growth of the seagrasses *Helodule uninervis* (Forskal) Aschereon and *Halophila ovalis* (R. Broun Hooker F) in marine culture ponds at Mandapam *Proceedings of the Second Indian Fisheries Forum*, Mangalore 51-53

CHAKRABORTY, S.K. 1994. Length weight relationship and biometric study on three species of sciaenids from Bombay waters *J. Indian Fish. Ass.* 22: 41-48 (1992)

CHAKRABORTY, S.K. 1994. Growth, mortality and stock assessment of *Nemipterus japonicus* (Bloch) from Bombay waters. *Indian J. Mar. Sci.* 24 : 107-109

CHANDGE, M.S. AND R. PAUL RAJ 1994. Nutritive value of natural liquid sources for Indian White Prawn *Penaeus indicus* H. milne Edwards. *Proceeding of Second Indian Fisheries Forum*, Mangalore 15-21

CHENNUBHOTLA, V.S.K., A.K.V. NASSER, V.A. KUNHIKOYA, A. ANASUKOYA AND M.S. RAJAGOPALAN 1994. Observations on the grazing phenomenon of the cultured seaweed *Gracilaria edulis* by fish in Minicoy lagoon (Lakshadweep). *Mar. Fish. Infor. Serv., T&E Ser.*, 127 : 11-12

DESHMUKH, V.D. 1994 Non-penaeid prawn resources. *Ibid.*, 130 : 5-8

DIWAN, A.D. AND SHOJI JOSEPH 1994. Induction of gamete activity in the Indian penaeid prawns. *Ibid.*, 133 : 15-19

DIWAN, A.D., SHOJI JOSEPH AND A. NANDA KUMAR 1994. Cryobanking potentials of marine shrimp gametes. *Ibid.*, 131 : 16-18

GANAPATHY, A. 1994. On a hawksbill turtle washed ashore near Thondi along Palk Bay coast of Tamil Nadu. *Ibid.*, 133 : 19

GOPINATHAN, C.P., J.X. RODRIGO AND H.M. KASIM 1994. Phytoplankton pigments in relation to primary production and nutrients in the inshore waters of Tuticorin, South east coast of India. *Indian J. Mar. Sci.*, 23: 209-212

* Titles of abstracts of papers presented at symposia/seminars are not included.

JAMES, D.B., R. MARICHAMY AND A. DEIVENDRA GANDHI 1994. Experiment on the culture of *Penaeus monodon* in the salt pan area at Tuticorin. *Proc. of the Second Indian Fisheries Forum*, Mangalore: 47-49

JAMES, D.B. AND K.C.S. PANICKAR 1994. On the recovery of a foetus of a sperm whale *Physeter macrocephalus* Linnaeus stranded at Chetlat island, Lakshadweep. *J. Bombay nat. Hist. Soc.* 91 (3) : 451

JAMES, D.B., M.E. RAJAPANDIAN, C.P. GOPINATHAN AND B.K. BHASKAR 1994. Break through in induced breeding and rearing of the larvae and juveniles of *Holothuria scabra* Jaeger at Tuticorin. *Bull. Cent. Mar. Fish. Res. Inst.*, 46 : 66-70

JAMES, P.S.B.R. 1994. The Indian Marine fisheries resources Scenario-past, present and future. *Indian, J. Fish.*, 39 (1,2) : 1-8 (1992)

JAMES, P.S.B.R., K.A. NARASIMHAM AND V. SRIRAMACHANDRA MURTY 1995. Technology for improving marine fishery production. pp 345-363 *in:* D.L. Deb (ed). *Sustaining Crop and Animal Productivity - The challenge of the Decade*, Associated Publishing Co, New Delhi 371 pp.

JAYASANKAR, P. AND S. KRISHNA PILLAI 1994. Observations on the fishery of croakers (Sciaenidae) in the trawling grounds off Rameswaram Island, *Mar. Fish. Infor. Serv., T&E Ser.*, 131: 11-15

KRISHNAKUMAR, P.K., E. CASILLAS AND U. VARANASI 1994. Effects of environmental contaminants on the health of *Mytilus edulis* from Puget Sound, USA. 1 Cytochemical measures of lysosomal response in the digestive cells. *Mar. Ecol. Prog. Ser.* 106: 249-261

KRISHNA SRINATH 1994. Awareness Campaign for fisherwomen, *Fishing Chimes*, 14(2): 14-15

KRISHNA SRINATH, S. KALAVATHI AND K.P. SALINI 1994. Evaluation of group discussion on the possibilities of developing oyster culture in Kerala. *Mar. Fish. Infor. Serv., T&E Ser.*, 131: 18-20

KRISHNA SRINATH, A.N. MOHANAN, K.P. SALINI AND MANPAL SRIDHAR 1994. Action Research for Rural Empowerment in Chellanam Fishing Village, Paper presented at the Seminar on Impact of CMFRI's outreach programmes in the Fishing Villages of Ernakulam District. *Ibid.*, 132: 2-6

KRISHNA SRINATH 1994. A Model for Participatory Development of Rural Women - *Indian Farming*, 43 (12): 22-23

KRISHNA SRINATH 1994. Repayment of institutional credit by fishermen, *Journal of Extension Education* Vol. 5, (4): 679-688

KRISHNA SRINATH 1995. Use of Traditional Media for Fisheries Communication, *Communicator*, January-March 1995. pp 48-49

LIPTON. A.P. 1994. Disease challenges and their management in intensive fish farming. *Seafood Export J.* XXV (16): 11-22

LIPTON, A.P. 1994. Instances of finless black porpoise, *Neophocaena phocaenoides* caught in Mandapam region along the Palk Bay Coast. Tamil Nadu. *Mar. Fish. Infor. Serv., T&E Ser.*, 127: 16-17

LIPTON, A.P. 1994. Shrimp diseases and control: Workshop on shrimp farming techniques, problems and solutions. *Madurai Kamaraj Univ. Res. manual*: 34-45

LIPTON, A.P. AND J.R. RAMALINGAM 1994. Skin of rays - A new commodity for export market. *Mar. Fish. Infor. Serv., T&E Ser.*, 127 : 13

LIPTON, A.P., S. KRISHNA PILLAI AND P. THILLAIRAJAN 1994. Observations on the culture of green mussels in Pillaimadom salt water lagoon near Mandapam. *Ibid.*, 127 : 8-11

LUTHER, G. 1994. Status of sardine fishery at Visakhapatnam. *Ibid.*, 133 : 1-10

LUTHER, G., C.V. SESHAGIRI RAO AND M.S. SUMITHRUDU 1994. The role of gillnet in the exploitation of lesser sardines. *Ibid.*, 133 : 10-14

MAHESWARUDU, G., E.V. RADHAKRISHNAN, N.N. PILLAI, M.R. ARPUTHARAJ, A. RAMAKRISHNAN, S. MOHAN AND A. VAIRAMANI 1995. *Penaeus semisulcatus* : A potential species for commercial culture along Tamilnadu coast. *Fishing Chimes* : 81-83

MARICHAMY, R., C.P. GOPINATHAN AND PON SIRAIMEETAN 1994. Studies on plankton production in the inshore waters of Tuticorin. *Proc. of the Second Indian Fisheries Forum*, Mangalore : 257-260

MARICHAMY, R., H. MOHAMED KASIM, K.M.S. AMEER HAMSA AND S. RAJAPACKIAM 1995. Survival of fish and prawn to industrial effluents with special reference to mercury. p. 110-119

MARICHAMY, R. AND S. RAJAPACKIAM 1995. Ecological monitoring of marine pollution along Tuticorin Coast. *Proc. of the National Symposium on Electrochemistry in marine Environment* : 44-52

MARTIN THOMPSON, P.K. AND K. ASOKAKUMARAN UNNITHAN 1994. Activities and achievements of Krishi Vigyan Kendra of Central Marine Fisheries Research Institute, Narakkal, Kerala. *Mar. Fish. Infor. Serv., T&E Ser.*, No. 132 : 9-12

MATHEW, K.J., G.S.D. SELVARAJ, T.S. NAOMI, MOLLY VARGHESE, N. SRIDHAR, MANPAL SRIDHAR, GEETHA ANTONY, K.S. LEELABHAI, R. ANILKUMAR AND K. SOLOMON 1994. Studies on the infestation of an isopod crustacean, *Cirolana fluviatilis* in some part of the Cochin backwaters, Kerala. *Ibid.*, 131 : 1-10

MENON, N.G., M. SRINATH, Y. APPANNASASTRY, S.G. RAJE, P.U. ZACHARIA AND M. FEROZ KHAN 1994. Stock assessment of marine cat fishes of India. *Indian J. Fish.*, 39 (1,2) : 65-84 (1992)

MOHAMED, K.S. AND A.D. DIWAN 1994. Vitellogenesis in the Indian White Prawn *Penaeus indicus* (Crustacea: Decapoda Penaeidae) *Journal of aquaculture in the tropics*, 9 : 157-172

MURTY, V.S., T. APPA RAO, M. SRINATH, E. VIVEKANANDAN, K.V. SOMASEKHARAN NAIR, S.K. CHAKRABORTHY, S.G. RAJE AND P.U. ZACHARIA 1994. Stock assessment of threadfin breams (*Nemipterus* Spp.) of India. *Indian J. Fish*, 39 (1, 2) : 9-41 (1992)

MURTY, V.S., M. SRINATH, P. LIVINGSTON, Y. APPANNASASTRY AND S. SREENIVASARENGAN 1994. Stock assessment of silverbellies of India with particular reference to Andhra Pradesh and Tamil Nadu. *Ibid.*, 39 (1, 2) : 42-64 (1992)

NAMMALWAR, P., A.P. LIPTON, S. KRISHNA PILLAI, G. MAHESWARUDU, C. KASINATHAN, M. BOSE, N. RAMAMOORTHY AND P. THILLAIRAJAN 1994. Instances of finless black porpoises *Neophocaena Phoceanoids* caught in Mandapam region along the Palk Bay coast in Tamil Nadu. *Mar. Fish. Infor. Serv., T&E Ser.*, 127 : 16-17

NAMMALWAR, 1995. Ecological effects of industrial pollution on the estuarine grey mullets with reference to aquaculture along the Madras coast. *Proceedings of Fourth National Symposium on Environment, Anna University, Madras*, pp 52-56

PAUL RAJ, R. 1994. Nutrition, feeds and feeding *In: Proc of the shrimp/ prawn Aquaculture A management perspective*, Aquastride, Madras, pp 59-70

PAUL RAJ, R. 1994. Utilising mangrove swamps for aquaculture. *In conservation of mangrove Forest genetic Resources: A Training.* M.S. Swaminathan Research Foundation, Madras. India and International Tropical Timber Organization Yokohna, Japan, pp. 383-392

PAUL RAJ, R. 1995. Hand-book on aquafarming: Aquaculture Feed MPEDA, Ministry of Commerce, Govt. of India 93 pp. (Reprinted)

PHILIPOSE, K.K. 1994. Fishery resources of Veraval, *Mar., Fish. Infor. Serv., T&E Ser.*, 126 : 1-5

PHILIPOSE, K.K. 1994. Lobster culture along the Veraval Coast *Ibid.*, 130 : 8-12

PILLAI, C.S.G. 1994. Coral reef ecosystems. Book review. *Indian J. Mar. Sci.*, 23 : 251-252

PILLAI, C.S.G. 1994. Commentary on the Adam's bridge and the coral reefs of Palk straits in *Johannes walther on reefs* Geological molestones Vol. 2 Univ. of Miami pp 115-117

PILLAI, V.K. AND K. ASOKAKUMARAN UNNITHAN 1994. Water quality management in aquaculture (Malayalam) 4th Swadeshi Science Congress 5-7 November, Ernakulam. pp. 71-77

RADHAKRISHNAN, SREELATHA MOHAN AND B. SURESHKUMAR 1994. Mushram cultivation (In Malayalam) *Krishi Vigyan Patrika* No. pp. 1-25

RADHAKRISHNAN, E.V. Sea ranching of spiny lobster. *Mar. Fish. Infor. Serv., T&E Ser.*, 124 : 5-8

RADHAKRISHNAN E.V. 1995. Commercial prospects for farming spiny lobsters. Aquaculture towards the twenty first century. *Proc. INFOFISH-AQUATECH '94* Conference, Colombo, Srilanka, 29-31 August 1994

RADHAKRISHNAN, E.V. AND M. VIJAYAKUMARAN 1995. Early larval development of spiny lobster, *Panulirus homarus* (Linnaeus 1758) reared in the laboratory. *Crustaceana* 68 (2) : 151-159

RAJE, S.G. AND V.D. DESHMUKH 1994. Unusual landing OF *H. ilisha* in gill nets at Versova. *Mar. Fish. Infor. Serv., T&E Ser.*, 128: 18

RAJE, S.G. AND V.D. DESHMUKH 1994. Occurrence of elongated caudal fin ray in males of *Nemipterus japonicus. Ibid.*, 126 : 17-18

RAJE, S.G. AND V.V. SINGH 1995. Fishing fleet maintenance at Versova. An example of emanciation through co-operation. *Fishing Chimes* Vol. 14. No. 11 : 42-44

RAO, T.A., R.S, LAL MOHAN, S.K. CHAKRABORTHY, V. SRIRAMACHANDRA MURTY, K.V. SOMASEKHARAN NAIR, E. VIVEKANANDAN AND S.G. RAJE 1994. Stock assessment of sciaenid resources of India. *Indian J. Fish.*, 39 (1, 2) : 85-103 (1992)

RAO, T. NAGESWARA AND P. VENKATARAMANA 1994. On the landing of Bottlenose dolphin *Tursiops trunacalus* at Kakinada. *Mar. Fish. Infor. Serv., T&E Ser.*, 127 : 16

REKHA J. NAIR AND MANPAL SRIDHAR 1994. Role of ratio size and feeding frequency in shrimp culture, *Fishing Chimes*, 46-47

SAID KOYA, K.P., Y.D. SAVARIA AND J.D. VANVI 1993. On a giant ray *Manta birostris* landed at Bhidiya in Veraval. *Mar. Fish. Infor. Serv., T&E Ser.*, 122 : 23

SATHIADHAS, R., K.K.P. PANIKKAR AND A. KANAKKAN 1994. Traditional Fishermen in Low Income Trap-A case study in Thanjavur coast of Tamil Nadu, *Ibid.*, 135 : 5-10

SATHIADHAS, R., R. NARAYANA KUMAR AND D.B.S. SEHARA 1995. Exploitation of Marine Fishery Resources and their Utilisation. *In:* proceedings of 4th Swadeshi Science Congress, November 5-7 1994. Ernakulam, pp. 20-25

SATHIADHAS, R., R. NARAYANA KUMAR AND R. REGHU 1995. Marine Fisheries Management for Sustainable Development (Malayalam version), CMFRI Extension Series No. 2, 24 pp

SATYA RAO, S. 1994. Heavy landings of Indian mackeral along Visakhapatnam coast. *Mar. Fish. Infor. Serv., T&E Ser.*, 128 : 19

SATYA RAO, S. 1994. Sea shells collection-an additional means of income for fishermen Muthyalammapalem South of Visakhapatnam, *Ibid.*, 128 : 18

SATYA RAO, S. AND S. CHANDRASEKHAR 1994. On the landing of spinner dolphin *Stenella longirostris* at Lawson's Bay, Visakhapatnam. *Ibid.*, 127 : 18

SATYA RAO, S., S. CHANDRASEKHAR AND M. PRASADA RAO 1994. Monofilament made bottom-set gill net proves more efficient along the Andhra coast. *Ibid.*, 128 : 17

SATYA RAO, S., S. CHANDRASEKHAR AND M. PRASADA RAO 1994. Prawn culture at Moolakoddu in Visakhapatnam district of Andhra Pradesh, *Ibid.*, 130 : 14-15

SATYA RAO, S., M. CHANDRASEKHAR, M. PRASADA RAO, S. CHANDRASEKHAR, R.V.D. PRABHAKAR AND M.S. SUMITHRUDU 1994. On the strike by sea food exporters at Visakhapatnam Fishery Harbour. *Ibid.*, 131 : 21

SATYA RAO, S., S. CHANDRASEKHAR, M. PRASADA RAO, J.B. VARMA, M.S. SUMITHRUDU AND K. NARAYANA RAO 1994. Prawn (*Penaeus monodon*) seed exploitation along the coast of Visakhapatnam and Vizingaram district of east coast of Andhra Pradesh. *Ibid.*, 135 : 11-12

SAVARIYA, Y.D. 1994. Scientific, common and vernacular names of commercially important fin and shell fishes. *Ibid.*, 134 : 1-4

SELVARAJ, G.S.D. 1994. Influence of Mangrove Ecosystem on the biological resources and fishery of Kakinada. *Mar. Fish. Infor. Serv., T&E Ser.*, 130 : 12-13

SIVADAS, M. 1994. Present status of drift net fishery at Vellayil Calicut. *Ibid.*, 127 : 1-4

SOMAYAJALU, K.R., K. DHANARAJU, P. ACHAYYA, V. ABULU, P. RAMALINGAM CH.E. THATHAYYA, T. NAGESWARA RAO, P.V. RAMANA AND N. BURAYYA 1994. Prawn seed exploitation along Kakinada coast, a preliminary apparaisal with a note on the brooder exploitation of *Penaeus monodon*. *Ibid.*, 130 : 1-5

SRIDHAR MANPAL, 1994. Technical and Economic considerations for shrimp feed production at South Chellanam, Ernakulam District - I. Background information. *Ibid.*, 132 : 12-14

SRIDHAR MANPAL, 1994. Technical and Economic considerations for shrimp feed production at South Chellanam Ernakulam District-II. Field trials and on-farm training on feed preparation. *Ibid.*, 132 : 15-18

SRIDHAR MANPAL, AND M. PEER MOHAMED 1994. Status of feed management. *Fisheries World* 1 (11) : 20-24

SRIDHAR MANPAL, 1995. Towards practical shrimp feed formulations. *Ibid.*, 2 (10) : 24-27

SRIDHAR MANPAL AND M. PEER MOHAMED 1995. Significance of Farm made feeds in the Indian context. *Fishing Chimes*, 15(4) : 45-46

SRIDHAR MANPAL, REKHA J. NAIR AND N. SRIDHAR 1995. Trypsin activity as a function of variation in shrimp *Penaeus indicus*. *Indian J. Mar. Sci.* 124 : 110-112

SUDHAKARA RAO, G. 1993. An appraisal of the fishery of *Metapenaeus monoceros* along Kakinada coast. *J. mar. biol. Ass. India* 35 (1&2) : 57-73

SUSEELAN, C. AND K. PRABHAKARAN NAIR 1994. Endangered vulnerable and rare estuarine shell fishes of India. *In* P.V. Dehadrai P. Das and S.R. Verma (eds) *Threatened fishes of India*. Nation Publication, 4 : 237-251

SYDA RAO, G. 1994. Live clam meat as most efficient and effective flavouring agent in the feeds of prawns and crabs in the culture farms. *Fishing Chimes*, 14(1) : 17

SYDA RAO, G., K.R. SOMAYAJULU AND P. ACHAYYA 1994. Prospects for developing culture of edible oyster *Crassostrea madrasensis* and green mussel, *Perna viridis* along Kakinada coast, Andhra coast. *Mar. Fish. Infor. Serv., T&E Ser.*, 135 : 1-5

THIRUMILU, P., P.K. MAHADEVAN PILLAI, P. POOVANNAN AND M. BOSE 1994. Specifications different artisanal and mechanised fishing crafts employed in marine fisheries along Tamil Nadu coast. *Ibid.*, 128 : 8-12

VICTOR, A.C.C., A. CHELLAM, S. DHARMARAJ AND T.S. VELAYUDHAN 1994. Recent development in pearl oyster research in India. Pearls '94 conference, Hawai, May 15-19, 1994. *Journal of shellfish Research*, Vol. 13 (1)

VICTOR, A.C.C., A. CHELLAM, S. DHARMARAJ AND T.S. VELAYUDHAN 1994. Aquaculture of marine pearl oysters and pearl production. Hindi Seminar on Marine living Resources and Aquaculture, CIFE, Bombay. Nov. 22, 1994

VIJAYAN, K.K. AND A.D. DIWAN 1994. The mandibular organ of the prawn *Penaeus indicus* H. Milne Edwards and its in consequential role in moulting process. *J. Aqua. Biol.* (1&2) : 45-46

VIJAYAKUMARAN, K. AND K.P. PHILIP 1994. On a pelagic thresher *Alopia pelagicus* caught off North of Kakinada. *Mar. Fish. Infor. Serv. T&E Ser.*, 133 : 19

VIJAYAKUMARAN, K. 1995. Book review - Threatened fishes of India. *Fishing Chimes*, 14 (12) : 57

VIVEKANANDAN, E. 1995. Application of bioenergetics in aquaculture In: *Aquaculture* (Ed) T. Subramoniam, B. 1. Publ. Bombay

VIVEKANANDAN, E. AND P. DEVADOSS 1995. Resources of culturable marine fishes. In *Aquaculture* (ed) T. Subramoniam B.1. Publ. Bombay

MEETINGS, CONFERENCES, SYMPOSIA, WORKSHOPS ATTENDED

Name & Designation	Meeting/Symposium/Workshop etc.	Organisation, place	Date/s
Dr. P.V. Rao, Director	Discussions with Quinquennial Review Team	Mangalore, Karwar and Veraval Research Centres of CMFRI	12-14 May and 10-15 June, 1994
	Review of the Ocean Related Remote Sensing Project of Dept. of Ocean Development	Space Application Centre, Ahmedabad	14 June 1994
	Joint Council Meeting	CMFRI, Mandapam Camp	25 August 1994
	Discussion meeting with the Chief Conservator of Forests relating to acquisition of land for Karwar Research Centre of CMFRI	Bangalore	23 September 1994
	Academic Council Meeting	CIFE, Bombay	24 September 1994
	Felicitation meeting for Dr. R.S. Paroda, Director General, ICAR	IARI Auditorium, New Delhi	21 October 1994
	Annual Meeting of ICAR Directors	New Delhi	7-8 October, 1994
	National Workshop on Computer Aided Taxonomy for Marine Biota	National Institute of Oceanography Goa	10-11 November 1994
	Regional Workshop on Situation Analysis of Coastal Fisheries in the Bay of Bengal	BOBP, Madras	15-16 December 1994
	Meeting with the Fisheries Development Commissioner on implementation of the Project on Ornamental Fishes of Lakshadweep	Ministry of Agriculture, New Delhi	22 December 1994
	The Steering Committee on Marine Satellite Information Service (MARSIS) of Department of Ocean Development	NRSA, Hyderabad	12 January 1995
	Lectures at the Refresher Course on Fisheries and Sea Farming	CIFE, Bombay	23 January 1995
	Inspection of the construction work of *Penaeus monodon* hatchery for M/s Sterling Shrimpex, under the consultancy programme	Kothapet, Chirala	16-17 February 1995

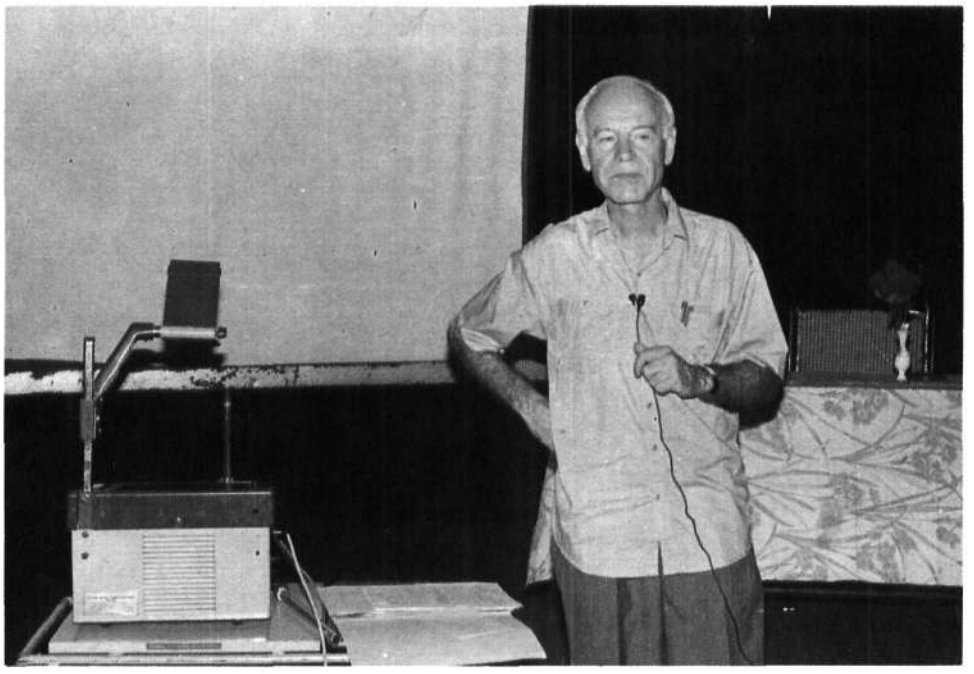
Name & Designation	Meeting/Symposium/Workshop etc.	Organisation, place	Date/s
Shri R. Marichamy Principal Scientist	Meeting of Management Committee	CMFRI, Cochin	6th April 1994
	Lecture on 'Site selection for prawn farming' for the participants of Training Programme on prawn farming	Kamaraj College, Tuticorin	11 April 1994
	National Symposium on Electro-chemistry in Marine Environment. A paper entitled 'Ecological Monitoring of Marine Pollution along Tuticorin coast' was presented.	Madras	7-8 February 1995
	Brain Storm session - An evaluation of students' performance in National Educational Tests sponsored by Tamil University and Dept. of Science & Technology	V.O.C. College Tuticorin	9 April 1994
	Radio talk in Tamil to be broadcast by All India Radio, Tirunelveli on 'Kalimuga Nandugal' (Estuarine Crabs)		29 July 1994
Dr. C.S. Gopinadha Pillai Principal Scientist	Fourth meeting of the National Committee on Wetlands, Mangroves and Coral Reefs	Ministry of Environment and Forests, New Delhi	20 July 1994
	International Congress on Kerala Studies	Trivandrum	27-29 August 1994
	Seminar on appraisal of artificial reefs organised by the Programme for community organisation	Pozhiyoor, Trivandrum	
	National Workshop on Computer aided Taxonomy	National Institute of Oceanography, Goa	9-11 November 1994
Dr. V. Narayana Pillai Principal Scientist	Three meetings in connection with the presentation of the achievements of FORV *Sagar Sampada* before Parliament Committee for the Department of Science and Technology, Dept. of Ocean Development and Ministry of Commerce.	New Delhi	2-3 April 1994

Name & Designation	Meeting/Symposium/Workshop etc.	Organisation, place	Date/s
	International seminar on Biodiversity Conservation; presented a paper on marine biodiversity with special reference to waters around the subcontinent	INTACH, New Delhi	7-8 November 1994
Dr. D.B. James Senior Scientist	Brain storm session - An evaluation of students performance in National Educational Tests sponsored by Tamil University and Dept. of Science and Technology	V.O.C. College Tuticorin	9 April 1994
	National Symposium on Aquaculture for 2000 A.D. Presented a paper entitled 'Experiments on rearing of the juveniles of *Holothuria scabra* (Jaeger) produced in the hatchery'	Madurai Kamaraj University, Madurai	27 November 1994
	Interview in Tamil on sea cucumbers to be broadcast, to All India Radio	Tirunelveli	25 April 1994
Shri D. Sivalingam Scientist SG	National Symposium on Aquaculture for 2000 A.D.	Madurai Kamaraj University, Madurai	26th & 27th November 1994
Dr. A.C.C. Victor Senior Scientist	Lecture on present status on Molluscan Fisheries in India and on pearl oyster farming & pearl culture	Academic College, Banaras Hindu University, Varanasi	14 April 1994
Dr. R. Paul Raj Sr. Scientist	Regional Workshop on Situation Analysis of Coastal Fisheries in the Bay of Bengal; presented the situation analysis relating to "Coastal Aquaculture Related Management Problems in Coromandel Coast"	BOBP, Madras	15-16 December 1994
	National Workshop on Transfer of Technology for Sustainable Shrimp Farming organised by the CIBA, Madras, MPEDA, Ministry of Agriculture	M.S. Swaminathan Research Foundation, Madras	9-10 January 1995
	Seminar on East Coast. Presented a paper on Prawn Culture along the coast, Worldwide Fund for Nature, India	Madras	3 March 1995

Name & Designation	Meeting/Symposium/Workshop etc.	Organisation, place	Date/s
Dr. P. Nammalwar Sr. Scientist	National Symposium on Electrochemistry in Marine Environment	Central Electro-chemical Research Unit, Madras	7-8 February 1995
Dr. E. Vivekanandan Sr. Scientist	Presented the Situation Analysis Report for Madras coast, Bay of Bengal Programme	Madras	December, 1994
Shri G. Subbaraju Principal Scientist	Kissan Mela organised by Deputy Director of Fisheries, A.P.	Kakinada	16 February 1995
	Kissan Mela organised by APAU	Kakinada	29 March 1995
Miss. K.N. Saleela Scientist	Kissan Mela organised by Deputy Director of Fisheries, A.P.	Kakinada	16 February 1995
Dr. G. Luther Principal Scientist and Dr. G. Sudhakara Rao, Senior Scientist	Seminar on 'Seafood Industries and their Export Prospects' jointly organised by Small Industries Service Institute, Small Industries Product Promotion Organization and the Seafood Exporters Association	Visakhapatnam	28 June 1994
Dr. G. Sudhakara Rao Sr. Scientist	Annual General Body meeting of the Association of Indian Fishery Industries	Visakhapatnam	29 September 1994
Shri K. Vijayakumaran Scientist	National, seminar on 'Blue Revolution: Progress, Problems & Prospects, jointly organised by Institute of Development and Planning Studies & Fishing Chimes	Visakhapatnam	25 June 1994
Dr. V.S.K. Chennubhotla Principal Scientist Dr. G. Sudhakara Rao, Senior Scientst Shri R. Sarvesan Scientist SG and Shri K. Vijayakumaran Scientist	Inaugural function of the training programme on "Environmental and Disease Problems in Brackishwater Aquaculture - their management"	Dept. of Marine Living Resources, Andhra University	15 February 1995
Dr. V.S.K. Chennubhotla Principal Scientist Dr. G. Sudhakara Rao, Senior Scientist	Meeting on the 'Results of Experimental Field Trials of Selective Shrimp Fishing Project'	CIFNET, Visakhapatnam	17 February 1995

Name & Designation	Meeting/Symposium/Workshop etc.	Organisation, place	Date/s
Dr. P.A. Thomas Senior Scientist	Annual meeting of the D.O.D. Project entitled "Drugs from the Ocean"	Algal Research Centre, Mandapam	January 1995
Dr. N. Kaliaperumal Senior Scientist	National Symposium on Algae and their Utilisation organised by the Seaweed Research and Utilisation Association	Madras	2-6 September 1994
	National Symposium on Aquaculture for 2000 A.D. organised by the Dept. of Energy	Madurai Kamaraj University, Madurai	26-27 November 1994
Dr. Kuber Vidyasagar Sr. Scientist	Consultative Group Meeting of the Fishery Survey of India	Bombay	
Dr. Kuber Vidyasagar Sr. Scientist and Dr. V.V. Singh, Scientist	National Symposium and on Marine Living Resources and Aquaculture	CIFE, Versova, Bombay	22 November 1994
Dr. Kuber Vidyasagar, Sr. Scientst Dr. Alexander Kurian Sr. Scientist Dr. S.K. Chakraborty Sr. Scientist Dr. V.D. Deshmukh Sr. Scientist Shri S.G. Raje Scientist (SG) and Dr. V.V. Singh Scientist	National Symposium an "Aquacrops"	CIFE, Bombay	18-21 November 1994
Dr. R. Sathiadhas Sr. Scientist	Meeting convened by Development and Educational Communication Unit, Space Application Centre, ISRO, Ahmedabad to discuss the project on socioeconomic study of brackishwater sites in the State of Kerala	Ahmedabad	30 August 1994
Dr. (Mrs.) Krishna Srinath Sr. Scientist	Workshop on Redefining Strategies for Womens' development organised by High Level Advisory Committee on Women Oriented Schemes, Govt. of Kerala	Trivandrum	13-14 June 1994

Name & Designation	Meeting/Symposium/Workshop etc.	Organisation, place	Date/s
	Seminar on Empowerment for Decision-making organised by the Kerala State Womens' Development Corporation	Cochin	3 September 1994
Dr. Krishna Srinath and Dr. Manpal Sanhotra Scientists (SS)	Meeting convened by the District Development Committee regarding financing prawn feed production under IRDP, TRYSEM and DWCRA programmes	Cochin	29 November 1994
Shri P.E. Sampson Manickam Scientist (SG) and Dr. Krishna Srinath Sr. Scientist	Workshop on Investment Opportunities in Aquaculture organised by NABARD	Calicut	22-23 August, 1994
Dr. C. Suseelan Senior Scientist	15th Academic Council Meeting of CIFE	CIFE, Bombay	30 April 1994
Shri K. Asokakumaran Unnithan Technical Officer	Seminar on Paddy cum prawn farming in Vypeen Island arranged by the Dept. of Agriculture	Narakkal	20 June 1994
	Swadesi Science Congress	Cochin	5-7 November 1994
Shri K. Asokakumaran Unnithan and Dr. P.K. Martin Thompson Technical officers	Regional Workshop of KVK	Pattambi	27 May 1994
Dr. D. Noble Scientist (SG) and Shri K. Asokakumaran Unnithan, Technical Officer	Zonal Workshop of KVK	Pondicherry	27-29 June 1994



Dr. Karl Banse, Professor of Oceanography, University of Washington, giving a Seminar on "Zooplankton - Central to understanding marine organic production" on 6th March 1995

The distinguished audience at the Seminar

Parliamentary consultative committee of Ministry of Commerce under the Chairmanship of Shri K.P. Unnikrishnan, M.P. visited the Institute

Shri Ram Lal Rahi Honourable Deputy Minister for Home Affairs, Government of India, inaugurating the Functional Hindi Course

The Director of CMFRI and the external experts at the reconstituted SRC meeting

OUR GUESTS

COCHIN

Shri G.P. Singh, ICAR, Krishi Bhavan, New Delhi

Prof. B. Neelakantan, Karnataka University, Karawr

Shri A. Rahim, a trainee from Bangladesh

Shri D. Venu, Assistant Professor, Department of Marine Living Resources, Andhra University, Visakhapatnam

Shri V.G. Gangadharan, Principal, Government Regional Fisheries Technical High School, Valiathura, Trivandrum

Dr. P.S. Reddy, Madras Christian College, Madras

Shri Raizada, Senior Scientist, CIFE, Bombay

Prof. M.M. George, Newman College, Thodupuzha

Prof. S. Ananda Kumar, Prof. Dr. R. Narayana Prakash, VHNSN College, Virudhunagar

Dr. Ajmal Khan and Dr. M. Srinivasan, CAS in Marine Biology, Port Novo.

MANDAPAM

Shri S. Manickavasagam, Collector of Customs, Madras

Dr. K. Venkataramanujam, Dean, Fisheries College, Tuticorin

Dr. R. Santhanam, Professor, Fisheries College and Research Institute, Tuticorin

Shri A. Govindaraj, District Registrar, Ramnad

Dr. V. Gnanaprakasam, Vice-Chancellor, Tamil Nadu University for Veterinary and Animal Sciences

Dr. B.N. Krishna Murthy, Director, Department of Ocean Development, New Delhi

Shri D. Rajanayagam, District Revenue Officer, Ramnad

Shri K.V. Palanidurai, Member, State Planning Commission, Madras

Shri M. Soundarapandian, District and Sessions Judge, Ramnad

Fieui-Ardos Cazenave, Pasteur Institute, Paris

Shri R. Muthukaruppan, Vice-Chancellor, Bharathidasan University, Tiruchy

Cdr. N. Chopra, Naval Detachment, Rameswaram

Ms. Roslina Bt. A. Karim, Kuantan, Pahang DM, Malaysia

Dr. S.K. Bhanja, Director, NIRD, Hyderabad

Prof. D. Balasubramanian, Director, CCMB, Hyderabad

Prof. D. Wiehmam, Giezendanner, Ascona, Switzerland

Shri C. Wilson, Asst. Director, MPEDA, Thanjavur

Prof. M. Chowdhury, Post Graduate Dep. Zoology, Govt. College, Darjeling

Dr. Markul Huhni, Bellmunn, Switzerland

Dr. Bosse Paul, Zoersel, Belgium

Dr. M. Raja Shekar, Dept. Biosciences, Mangalore University

VERAVAL

Mr. N.G. Akolkar, Asst. Professor and 16 B.F.Sc. studens, College of Fisheries, Veraval

Dr. B.G. Kulkarni, Dept. of Bioscience, Bombay

Dr. Rishad Parvez, Lecturer, Dept. of Zoology, Gujarat University, Ahmedabad with 8 students of Second Year M.Sc.

Dr. G. Ragothamon, Reader & Head, Dept. of Aquatic Biology, South Gujarat University, Surat with 9 students of M.Sc.

Shri Ranjan Kumar Rant, Water Base Ltd., Nellore

MANGALORE

Dr. D. Sudarshan, Director General, Fishery Survey of India, Bombay

Dr. K.S. Udupa, Associate Professor, College of Fisheries, Kankanady, Mangalore

VIZHINJAM

Prof. D. Venkat Rao and Associates, Department of Pharmaceutical Sciencies, Andhra University, Visakhapatnam

Dr. Y. Venkateswarudu, Indian Institute of Chemical Technology, Hyderabad

Mr. Leourur Peter, University INNS BBUCH, Austria

TUTICORIN

Prof. J. Azariah, Professor of Zoology, University of Madras, Madras

Dr. K. Kameswara Rao, Dept. of Zoology, Andhra University, Waltair

Shri N. Krishnaswamy, Kothari Sugars & Chemicals, Madras

Shri Gyen Shankar, AQUASTRIDE, Madras

Shri Sundaramoorthy, MAC School of Aquaculture, Tuticorin GSE Team from Brazil

KAKINADA

Dr. M. Kaliya Murthy, Senior Scientist, CIFA, Kakinada with ARS Trainees

Shri D.K. Reddy, Director, DARE, New Delhi

VISAKHAPATNAM

Dr. S.C. Mukherjee, Head, Pathology Division, CIFA, Bhubaneswar

Shri A.S.K.V.S. Sharma, Asst. Editor, Science Reporter, Information Directorage (CSIR), New Delhi

Dr. E.G. Silas, former Director of CMFRI and former Vice-Chancellor of Kerala Agricultural University

Prof. P.K. Salian, Director of Instruction, College of Fisheries, Mangalore

Dr. R.C. Chaudhary, Professor, Department of Naval Architecture, IIT, Madras

Dr. A.B. Banerjee, Head, Bio-organic division, BARC, Trombay, Bombay

Shri A.N. Murthy, Under Secretary (Finance), DARE, New Delhi

CALICUT

Vocational lectures, Madapalli, V.H.S.E.

B.F.Sc. students and lectures, Fisheries College, Veraval

BOMBAY

QRT members consisting of Dr. S.V. Bapat, Dr. A.H. Parulekar, Dr. Vinayashil Gautam and Shri Anil Agarwal

OUR STAFF

(Centre-wise; Not a gradation list)

COCHIN - HEAD QUARTERS AND ITS FIELD CENTRES

Director

Dr. M. Devaraj

SCIENTISTS

PS

Dr. P. Vedavyasa Rao (Acting Director from Mar. 1994 to Feb. 1995)
Dr. M.S. Rajagopalan
Dr. M. Peer Mohamed
Dr. P. Bensam
Dr. K.A. Narasimham
Dr. C.S. Gopinadha Pillai
Dr. P. Parameswaran Pillai
Dr. V. Narayana Pillai
Dr. K. Alagaraja

Sr. S

Dr. N. Neelakanta Pillai
Dr. C. Suseelan
Dr. V. Kunjukrishna Pillai
Dr. K.J. Mathew
Dr. K. Rengarajan
Dr. C.P. Gopinathan
Dr. (Mrs.) V. Chandrika
Dr. K.S. Scariah
Dr. V. Sriramachandra Murty
Dr. N. Gopalakrishna Pillai
Dr. (Mrs.) S. Sivakami
Dr. N. Gopinatha Menon
Dr. M.K. George
Dr. P.C. Thomas
Dr. R. Sathiadas
Dr. (Mrs.) Krishna Srinath
Dr. P.N. Radhakrishnan Nair

S (SG)

Shri P.E. Sampson Manickam
Shri K.N. Rajan
Dr. (Mrs.) K. Mary Manissery
Shri K.R. Manmadan Nair
Shri K.G. Girijavallabhan
Shri G.S. Daniel Selvaraj
Shri R.N. Misra
Shri D.B.S. Sehara
Shri K. Balan
Shri A.A. Jayaprakash
Shri T.S. Velayudhan
Dr. K.C. George
Shri G. Nandakumar
Shri K. Narayana Kurup
Shri M. Srinath
Shri K.V. Somasekharan Nair
Mrs. Grace Mathew
Shri S. Muthuswamy

S (Sr. Scale)

Dr. N. Sridhar
Dr. (Mrs.) Manpal Sridhar
Dr. Naresh Kumar Verma

S

Mrs. T.S. Naomi
Mrs. K. Vijayalakshmi
Mrs. M.P. Molly
Mrs. V. Kripa
Shri T.V. Sathianandan
Shri P. Vijayagopal
Shri R. Narayanakumar
Shri N.K. Sanil
Shri B. Manojkumar
Shri A.P. Dinesh Babu
Mrs. Josileen Jose
Shri E.M. Abdussamed
Dr. (Miss) P. Laxmi Latha

PS: Principal Scientist, Sr. S: Senior Scientist, S(SG) Scientist (Selection Grade), S (Sr. Scale): Scientist (Senior Scale), S: Scientist

TECHNICAL OFFICERS

T-8

Shri S. Natarajan
Shri P.K. Velayudhan - Mate
Shri P.R. Leopold - Skipper

T-7

Shri G. Balakrishnan
Shri Varghese Philipose

T-6

Shri V. Rajendran

T-5

Shri P. Karunakaran Nair
Shri K.C. Yohannan
Shri Varughese Jacob
Shri G. Krishnankutty Nair
Shri K. Thulasidas
Mrs. V.P. Annam
Shri V.K. Balachandran
Shri M. Ayyappan Pillai
Mrs. K.S. Leela Bhai
Mrs. Geetha Antony
Shri Nirmal Mathew - Bosun
Shri N.B. Gopalakrishna Menon - Bosun
Shri B. Ramesh - Bosun
Mrs. C. Nalini
Shri K.N. Gopalakrishnan
Shri P.M. Aboobaker
Shri A.A. Thankappan
Shri V. Suresh
Shri R. Reghu
Shri K.L.K. Kesavan, Sr. Artist
Shri P. Raghavan, Photographer

SENIOR TECHNICAL ASSISTANTS

T-4

Shri K. Balachandran
Shri A. Nandakumar
Mrs. A. Kanagam
Shri A. Kanakkan
Shri V. Radhakrishnan Nair
Shri C.J. Prasad
Mrs. P.L. Ammini
Shri Joseph Andrews
Shri S. Haja Najmudeen

TECHNICAL ASSISTANTS

T-II-3

Smt. P. Ammajee - Sr. Lib. Asst.
Smt. S. Girijakumari - Sr. Lib. Asst.
Smt. P. Geetha - Lib. Asst.
Mrs. K. Ramani
Shri Mathew Joseph
Shri V.A. Narayanan Kutty
Shri D. Pugazhendi
Shri N. Palaniswamy

T-I-3

Shri K. Ramdoss Gandhi
Shri K. Chellappan
Mrs. K.K. Valsala
Shri M.N. Kesavan Elayathu
Shri L.R. Khambadkar
Shri J. Narayanaswamy
Shri C.K. Dandapani - Serang
Shri T.R. Sreekumaran - Oilman
Shri C.D. Davis - Motor Driver
Shri S. Yadaviah - Motor Driver
Shri M.N. Appukuttan Nair - Motor Driver
Shri K. Chacko - Projector Operator
Shri M.A. Vincent - Driver (Boat)
Shri M.K. Gopalakrishnan - Sr. Deckhand
Shri K.S. Leon - Sr. Deckhand
Shri A.K. Unnikrishnan - Cook
Shri K.K. Prabhakaran - Cook
Shri C.S. Xavier - Motor Driver
Shri K.K. Soman - Motor Driver
Shri K.K. Sankaran - Artist
Shri K.K. Bose - Driver (Boat)
Shri P. Bhaskaran - Sr. Deckhand
Shri K.P. Vijayan - Sr. Deckhand
Shri K.J. Mathew - Motor Driver

PUNCH CARD OPERATORS

T-I-3

Shri M. Ramachandran
Shri M.B. Seynudeen
Shri P.P. Pavithran
Mrs. Latha Khambadkar
Mrs. P.T. Mani
Shri K.P. George
Mrs. M.R. Beena
Shri K. Anandan
Shri G. Subbaraman

TECHNICAL ASSISTANTS

T-2

Shri K.C. Devassy - Deckhand
Shri P.K. Baby
Shri V. Mohan - Jr. Lib Asst.
Mrs. Suvarna Mahesh - Jr. Lib. Asst.
Shri K.M. Venugopalan
Mrs. P.K. Seetha
Mrs. P.M. Geetha - Museum Asst.
Shri K. Solamon
Mrs. K.P. Salini

FIELD ASSISTANTS

T-1

Shri N.P. Ramachandran
Miss. G. Chitra
Mrs. K.V. Rema
Shri V.R. Arunachalam
Shri D. Prakasan
Shri A. Udayakumar
Shri S. Nandakumar Rao
Shri K.N. Pushkaran
Mrs. T.N. Anandalakshmy
Shri R. Anil Kumar
Shri V.K. Suresh
Shri N.K. Harshan
Shri Thomas Kuruvila
Shri K.C. Pradeep Kumar
Miss. Sindhu K. Augustine

ADMINISTRATION

Sr. Adm. Officer

Shri P. Bapaiah

Sr. Fin. & Accounts Officer

Shri M.P. Chandrasekharan

Asst. Fin. & Accounts Officer

Shri K.U.K. Menon

Asst. Adm. Officers

Shri P. Aithappa Naik
Shri S. Subramanian

Asst. Director (O.L.)

Mrs. P.J. Sheela

Superintendents

Shri A. Narayanaswamy
Shri P.J. Davis
Mrs. T.K. Ponnamma
Shri P. Ganesan
Shri C. Balamamundinathan
Shri K. Nagarajan

Assistants

Shri N. Govindan
Shri M. Ganapathy
Shri N. Gopinathan
Shri T.N. Padmanabha Kurup
Mrs. K. Vijayalakshmi
Mrs. P.V. Mary
Mrs. T. Madhavi
Shri V. Mohanan
Shri S. Abdulla
Shri K.L.K. Padmanabhan
Shri M.J. John
Shri K. Arumugham
Shri V.V. Lakshminarayanan
Mrs. K.M. Annamma

Sr. Stenographer

Miss. M.A. Seetha

Stenographers

Shri K.M. Surendran
Shri C. Yohannan
Mrs. A.K. Omana
Shri C.N. Chandrasekharan

Junior Stenographers

Mrs. N. Ambika
Mrs. N.R. Letha Devi
Mrs. K.V. Sajitha
Mrs. K.J. Malathi Devi
Mrs. N. Yesoda
Shri C.G. Thomas
Shri R. Chandrakesa Shenoy
Shri K.N. Murali

Senior Clerks

Shri V.P. Unnikrishnan
Shri M.K. Abdulla
Mrs. P.K. Sreedevi
Mrs. K. Santha

Shri P.V. Devassy
Mrs. V. Parukutty
Shri V. Chandrasekharan
Shri Thomas Joy
Mrs. M.O. Leela
Mrs. M. Suseela
Mrs. Christina Joseph
Mrs. Alice Valooran
Mrs. M.M. Teresakutty
Mrs. K.C. Girija
Mrs. A.K. Kunjipennu
Mrs. K.C. Karthiayani
Shri A.P. Balakrishnan
Mrs. A. Ranjini
Mrs. V.K. Sobha

Junior Clerks

Shri K.J. Mathew
Mrs. K. Balamani - Hindi Typist
Shri P.P. Anilkumar
Mrs. N.S. Sarala
Shri P.M. Bhaskaran
Shri C.K. Sivadas
Mrs. Gouri Hareendran
Mrs. M.G. Chandramathy
Mrs. G. Ponnamma
Shri Benny Mathew
Shri V.C. Antony
Shri D. Augustin Julin Raj
Shri K.M. Joseph
Mrs. I.M. Baby Rajalakshmi
Mrs. P.K. Mary
Mrs. D. Lalithambika Amma
Mrs. Binny Cherian
Mrs. N.G. Supriya
Mrs. K.N. Meera
Mrs. P.S. Sumathy
Shri Rishikesh Andi
Miss. N.M. Ponnamma
Shri V.C. Subhash
Mrs. G. Ambika
Mrs. N.K. Suseela
Shri K. Baburajan
Shri K. Ramadasan
Mrs. V. Jayalakshmi
Mrs. K.K. Kousallia
Shri K. Sadanandan

AUXILIARY STAFF

Mrs. E.K. Uma - Sr. Hindi Translator
Mrs. E. Sasikala - Hindi Translator
Shri V.A. Surendran - Motor Driver
Shri A. Rajan - Driver
Shri B.K. Velukutty - Driver
Shri K.G. Radhakrishnan Nair - Driver
Shri A. Ravindranathan Nair - Sr. Gestetner Operator
Shri M. Krishnan - Binder
Shri M.R. Bharathan - Deckhand

SUPPORTING STAFF

SSG-IV

Shri P.A. Vasudevan - Lab attendant
Shri M.L. Antony - Lab attendant
Shri K.P. Joseph - Lab attendant
Shri M.K. Peethambaran - Fieldman
Shri T.A. John - Khalasi
Mrs. N. Leela - Daftry

SSG-III

Shri K.S. Vaidyalingam - Fieldman
Shri E.F. Francis - Watchman
Shri A.P. Sebastian - Peon
Shri T.A. Vijayan - Peon
Shri N.T. Velappan - Peon
Shri P.A. Vasu - Fieldman

SSG-II

Shri B. Zainudheen	Watchman
Shri K.T. Rajappan	"
Shri P.K. Achuthan	"
Shri K. Velayudhan	"
Shri G. Vijayan	"
Shri G. Mithralal	"

SSG-II

Shri T. Vijayakumar	Messenger
Shri M.P. Mohandas	"
Shri T.M. Abdul Aziz	"
Shri K.C. Hezhakiel	"
Shri T. Sreedharan	"
Shri G. Gopinathan	"
Mrs. R. Devalakshmi	"
Miss B. Savithri	"

Shri C.O. Viswambaran Safaiwala
Mrs. K.K. Kalliani "
Shri V.C. Gopi "
Shri N.P. Mohanan "

SSG-I

Shri P.K. Ravindran Watchman
Shri K.C. Rajappan "
Shri E.J. James "
Shri V.T. Ravi "
Shri K. Velayudhan "
Shri Justin Joy K.M. "
Shri P.K. Chellappan "
Shri P. Satheesh Kumar Messenger
Shri P.V. Gopalan "
Shri V. Krishnan "
Mrs. Pennamma Joseph "
Shri T.I. Soman "
Shri V.A. Kuttappan "
Shri R. Ravindranathan Nair "
Shri M. Radhakrishnan "
Mrs. V.S. Savithri "
Mrs. S. Seethalakshmi "
Mrs. K.T. Prakashini "
Shri S.P. Prasad "
Miss. P.P. Sheela "
Mrs. S. Usha "
Shri T.P. Aboobacker Messenger
Miss. K. Sujatha "
Shri V.H. Venu - Binder
Mrs. J. Sudhadevi - Cane Weaver
Shri T.K. Antony - Lift Operator
Shri S. Mohanan - Lift Operator
Shri S. Narayanan Achari - Lab attendant
Shri N.V. Thambi - Lab attendant
Shri M.K. Anil Kumar Fieldman
Shri P.V. Joy "
Shri P.S. Alloycious "
Shri P.B. Jeevaraj "
Shri P.V. Sunil "
Shri A.K. Shaji "
Shri M.N. Sathyan "
Shri K.S. Ajith "
Shri P.M. Gireesh "
Shri P.D. Karunakaran Safaiwala
Shri B. Babu "
Miss. A. Latha "
Mrs. M.P. Shyamala "
Shri M.T. Vijayan "
Shri K.M. Sreekumar "
Mrs. P.K. Usha "
Miss. K.K. Sujatha "
Shri K. Sankaran Gardeners
Shri K.G. Jayaprasad "

KRISHI VIGYAN KENDRA/TRAINERS' TRAINING CENTRE
NARAKKAL

SCIENTISTS

PS

Dr. M.M. Thomas

Sr. S

Dr. D. Noble

TECHNICAL OFFICERS

T-8

Shri K. Asokkumaran Unnithan

T-7

Dr. P.K. Martin Thompson
Shri K.N. Rasachandra Kartha

T-5

Mrs. P. Sreelatha Mohan
Shri P. Radhakrishnan
Shri A.N. Mohanan

T-4

Shri B. Suresh Kumar

T-I-3

Shri P.J. Sebastian

ADMINISTRATION

Superintendents

B. Vijayakumar
Mrs. D. Geetha

Junior Stenographers

Shri C.D. Manoharan
Mrs. P.K. Anitha

Junior Clerks

Shri M.J. Tomy Prince
Shri N.K. Mohanan

SUPPORTING STAFF

SSG-III

Shri K.P. John (Fieldman)
Shri N.K. Asokan (Fieldman)
Shri K. Ganesan (Fieldman)

SSG-II

Shri K.G. Bhaskaran Nair (Messenger)
Shri K.N. Balan (Fieldman)

SSG-I

Mrs. Chinnamma Anjalo (Safaiwala)

CHAVAKAD FIELD CENTRE

FIELD ASSISTANT

T-1

Shri K.G. Baby

QUILON FIELD CENTRE

TECHNICAL OFFICER

T-5

Shri S.B. Chandrangathan
Shri M. Babu Philip

FIELD ASSISTANT

T-1

Shri C. Unnikrishnan

ALLEPPEY FIELD CENTRE

FIELD ASSISTANT

T-1

Shri A.Y. Jacob

MANDAPAM CAMP - REGIONAL CENTRE AND ITS FIELD CENTRES

PS

Dr. A.D. Diwan

Sr. S

Dr. N. Kaliaperumal
Dr. A.P. Lipton
Dr. A. Reghunathan

S(SG)

Shri D. Kandasami
Shri V. Gandhi

S(SS)

Dr. P. Jayasankar

S

Dr. Mohan K. Zachariah
Mrs. Reeta Jayasankar
Shri Maheswarudu Gidda
Mrs. Sheela Emmanuel

TECHNICAL OFFICERS

T-5

Shri S. Kalimuthy
Shri M. Badruddin
Shri C. Kasinathan - Curator
Shri P. Thankappan - Foreman

T-4

Dr. K. Muniyandi
Shri A. Ganapathy
Shri S. Palanichamy
Shri V. Edwin Joseph - Sr. Lib. Asst.
Shri T.K. Sudhakaran - Bosun

TECHNICAL ASSISTANTS

T-II-3

Shri K. Muthiah
Shri M.R. Arputharaj

T-I-3

Shri S. Mohan
Shri R. Subramanian
Shri A. Ramakrishnan
Shri M. Bose
Shri T.P. Haridasan - Carpenter
Shri R. Marimuthy - Painter-cum-Polisher
Shri A. Muniyandi - Artist
Shri M. Rengan - Cook (Boat)
Shri Mohammed Jaffer - Motor Driver
Shri S. Mohideen Meerasa - Sr. Deckhand
Shri R. Sekhar - Deckhand
Shri M. Ibrahim - Deckhand
Shri P. Munisamy - Deckhand
Shri D. Muthukaruppan - Motor Driver

JUNIOR TECHNICAL ASSISTANTS

T-2

Shri K. Alagirisamy - Motor Driver
Shri V. Sathiyanesan - Jr. Lib. Asst.
Shri N. Ramamurthy - Museum Assistant

FIELD ASSISTANTS

T-1

Shri A. Gandhi
Shri V. Sethuraman
Shri K. Jayabalan
Shri A. Shanmughavelu
Shri A. Viramani
Shri Palanichamy
Shri Sanjay Kumar Rana - Mechanic
Shri M. Shanmughavelu - Refrigeration Mechanic

AUXILIARY

T-1

Shri A. Srinivasan - Motor Driver

ADMINISTRATION

Asst. Adm. Officer

Shri R. Kuppuswamy

Superintendent

Shri M. Ramakrishnan

Assistants

Shri V.M. Mariappan
Shri A. Kajeendran
Shri S. Nagarajan
Shri K. Maragathavadivelu
Shri V. Chandran
Shri S. Jayachandran

Senior Clerks

Shri P. Selvaraj
Shri A. Yagappan
Shri M. Natarajan

Junior Stenographer

Mrs. N. Gomathi

Junior Clerks

Mrs. S. Parisa
Mrs. M. Rameswari
Shri U. Purandara Shetty

SUPPORTING STAFF

SSG-IV

Shri A. Munisamy - Lab Attendant
Shri A. Raman - Fieldman

SSG-III

Shri M. Chinnasamy Lab Attendant
Shri S. Muthuramalingam "
Shri M. Ibrahimsa "
Shri R. Nagan Fieldman
Shri A. Subramanian "
Shri S. Mani "
Shri S. Pitchai - Daftry
Shri K. Vellayan Watchman
Shri M. Govindaraj "
Shri G. Saivadurai "
Shri K. Munisamy "
Shri P. Karuppiah "
Shri M. Ramu "
Shri R. Sonal "
Shri K. Muthiah "
Shri K. Gurusami Safaiwala
Shri R. Alagon "
Shri A. Mari "
Shri M. Muthu "
Shri R. Savugan "
Shri V. Santhanam "
Shri K. Kuruvan "

SSG-II

Shri S. Arumugan Safaiwala
Shri R. Sonaimuthu "
Mrs. J. Kondamma "
Shri G. Ankaiah "
Mrs. S. Nagammal "
Shri L. Sathan "
Shri S. Murugan "
Shri P. Ramu Watchman
Shri M. Thangavelu "
Shri S. Arulsamy "
Shri K. Thangavelu Fieldman
Shri M. Kubera Ganesan "
Shri Hameed Sulthan - J.Pump Driver
Shri Y. Balu - Oilman
Shri M. Athimoolam - Cook

SSG-I

Shri T. Thananjayan Fieldman
Shri Sikkender Patcha S.M. "
Shri P. Villan "
Shri F. Arul Pragasam - Binder
Shri K. Govindan - Khansama
Shri K.U. Raman - Khalasi
Shri M. Shanmughavelu - Messenger
Shri G.K. Rajan - Pump Driver
Shri M. Shahu Hameed - Messenger
Shri V. Narashimma Bharaty - Daftry
Shri K. Shanmughanathan Lab Attendant
Shri M. Seeni "
Shri V. Munisamy "
Shri T. Syed Sadiq "
Shri M. Bareen Mohamed "
Shri K. Jeevanathan "
Shri A. Yesudhas "
Shri E. Natarajan "
Shri C. Ramadass "
Shri S. Murugaboopathy "
Shri N. Ramakrishnan "
Shri M. Sarvana Kumar Safaiwala
Mrs. Subbalakshmi "
Shri N. Nagamuthu "
Shri U. Rajendran "
Shri N. Rajavelu Watchman
Shri S. Balakrishnan "
Shri V. Alagan "

NAGAPATINAM FIELD CENTRE

TECHNICAL ASSISTANTS

T-I-3

Shri V. Thanapathy
Shri R. Somu
Shri V. Sivaswami

PATTUKOTTAI FIELD CENTRE

TECHNICAL ASSISTANT

T-I-3

Shri Vaithianathan N.
Shri A. Kumar
Shri P. Palani

FIELD ASSISTANT

T-1

Shri B. Thangaraj

VERAVAL RESEARCH CENTRE AND ITS FIELD CENTRES

SCIENTISTS

Sr. S

Dr. S. Lazarus

S

Shri K.P. Said Koya
Dr. K.K. Joshi
Shri P.P. Manojkumar

TECHNICAL ASSISTANTS

T-I-3

Shri B.P. Thumber
Shri H.K. Dhokia
Shri Y.D. Savaria

JUNIOR TECHNICAL ASSISTANTS

T-2

Shri Polara Jamnadas Premji
Shri Bharada Arjan Panchabhai
Shri Ladani Amrutlal Arjanbhai
Shri G.N. Chudasama - Motor Driver
Shri J.D. Vanvi
Shri M.S. Zala

FIELD ASSISTANT

T-1

Shri Chudasma Ramji Raja

ADMINISTRATION

Junior Clerks

Shri J.N. Jambudiya
Shri M.M. Vanvi

SUPPORTING STAFF

SSG-II

Shri H.M. Bhint - Messenger
Shri A. Abubin Mehsan - Watchman
Shri L.M. Waghale - Watchman

SSG-I

Shri Makwana Somapitha
Shri H.K. Makwana

JAMNAGAR FIELD CENTRE

JUNIOR TECHNICAL ASSISTANT

T-2

Shri B.V. Makadia

FIELD ASSISTANT

T-1

Shri Singothu Venkta Subha Rao

BOMBAY RESEARCH CENTRE AND ITS FIELD CENTRES

SCIENTISTS

Sr. S

Dr. Kuber Vidyasagar
Dr. Alexander Kurian
Dr. S.K. Chakraborty
Dr. V.D. Deshmukh

S(SG)

Shri M. Zaffar Khan

S(SS)

Shri S.G. Raju
Dr. Veerendra Veer Singh

S

Shri M. Aravindakshan

TECHNICAL OFFICER

T-5

Shri M. Shriram

TECHNICAL ASSISTANTS

T-II-3

Shri K.B. Waghmare

T-I-3

Shri J.D. Sarang
Shri R. Dias Johny
Shri A.D. Sawant
Shri C.J. Josekutty
Shri P.S. Gadenkush - Motor Driver

JUNIOR TECHNICAL ASSISTANTS

T-2

Shri A.Y. Mestry
Shri B.B. Chavan

FIELD ASSISTANTS

T-1

Shri B.G. Kalbate
Shri J.S. Motagi
Shri Thakur Das
Shri S.K. Sujit

ADMINISTRATION

Senior Clerks

Ms. P.V. Shanbhag
Shri M.R. Wadadkar

Junior Clerk

Ms. A.A. Sawant
Shri R.B. Bangare

Junior Stenographer

Shri R.D. Medar

SUPPORTING STAFF

SSG-IV

Shri B.T. Talpade - Lab Attendant

SSG-II

Shri S.M. Tandel - Watchman
Shri K.G. Tawade - Watchman

SSG-I

Mrs. R.S. Tumbe - Messenger
Mrs. Urmila Suresh Valmiki - Safaiwala
Shri M.P. Jadhav - Watchman
Shri D.D. Jangam - Watchman
Shri K.K. Baikar - Fieldman
Shri P.S. Salvi - Messenger

RANDER FIELD CENTRE

JUNIOR TECHNICAL ASSISTANT

T-2

Shri S.D. Kamble

DHAHANU FIELD CENTRE

FIELD ASSISTANT

T-1

Shri Suresh Krishna Rao Kamble

JANGIRAMURUD FIELD CENTRE

JUNIOR TECHNICAL ASSISTANT

T-2

Shri Ramesh B. Kamble
Shri D.G. Jadhav

RATNAGIRI FIELD CENTRE

JUNIOR TECHNICAL ASSISTANT

T-2

Shri Baban N. Katkar

FIELD ASSISTANT

T-1

Shri D.D. Sawant

MALVAN FIELD CENTRE

FIELD ASSISTANTS

T-1

Shri Kishor Reghunath Mainkar
Shri Bharamu S. Melinmani

KARWAR RESEARCH CENTRE AND ITS FIELD CENTRE

SCIENTISTS

Sr. S

Dr. V.S. Kakati

S(SG)

Shri P. Livingston
Shri M.E. Rajapandian

S

Miss Preetha Kochaniyan

TECHNICAL ASSISTANTS

T-I-3

Shri N. Chennappa Gowda
Shri C.K. Dinesh
Shri Maruthi S. Naik
Shri V. Varadaiah - Motor Driver

JUNIOR TECHNICAL ASSISTANTS

T-2

Shri K.C. Pandurangachar
Shri V.M. Dhareshwar
Shri S. Satyanarayan V. Pai
Shri U.V. Arghakar
Shri T.B. Harikantra

FIELD ASSISTANTS

T-1

Shri M.E. Durghakar
Shri N.G. Vaidya
Shri M.P. Harikantra (Serang)

ADMINISTRATION

Assistant

Shri G.K. Kudalkar

Senior Clerks

Shri Y.H. Gamanagaty
Shri Gangadhar B. Naik

Junior Clerk

Shri Ganesh R. Nadig

SUPPORTING STAFF

SSG-IV

Shri G.M. Korar - Fieldman

SSG-II

Shri M.R. Kotharkar Watchman
Shri L.K. Suvarna "
Shri M.B. Kotharkar "
Shri Subhash K. Naik - Messenger

SSG-I

Shri Rajendra D. Hulswar Watchman
Shri Harish Chandra Naik "
Shri Somayya S. Gonda "
Miss. Premila Shiva Palekar - Messenger
Shri Chandrakant G. Ulvakar - Fieldman
Mrs. Somi M. Harijan - Safaiwala

GOA FIELD CENTRE

JUNIOR TECHNICAL ASSISTANT

T-2

Shri P.C. Shetty

MANGALORE RESEARCH CENTRE AND ITS FIELD CENTRE

SCIENTISTS

S(SG)

Shri C. Muthiah
Shri K.K. Sukumaran

S(SS)

Dr. K. Sunilkumar Mohamed
Dr. P.K. Krishnakumar

S

Shri P.U. Zachariah
Mrs. Prathibha Rohit

TECHNICAL ASSISTANTS

T-I-3

Shri Y. Muniyappa
Shri S. Kemparaju
Shri B. Sridhara
Shri D. Nagaraja
Mrs. Uma S. Bhat
Mrs. Alli C. Gupta
Shri G. Subramanya Bhat

JUNIOR TECHNICAL ASSISTANTS

T-2

Shri H. Vasu
Shri C. Purandhara
Shri H.S. Mahadevaswamy

FIELD ASSISTANTS

T-1

Shri Lingappa
Shri M. Chaniappa
Shri G. Sampath Kumar

ADMINISTRATION

Assistant

Shri Balakrishna Naik

Senior Clerks

Shri K.M. Abdulla
Shri K. Rama Naik

Junior Clerk

Mrs. Martha R. Mascarenhas

AUXILIARY STAFF

Shri P. Narayana Naik - Motor Driver

SUPPORTING STAFF

SSG-II

Shri A. Keshava - Watchman
Shri D. Gangadhara Gowda - Watchman

Shri U.B. Sadasiva - Lascar
Shri Mohan S. Puthran - Oilman
Shri Ramana Sapaliya - Watchman

SSG-1

Mrs. Savithri - Fieldman
Shri S. Mahalinga Naik - Watchman
Mrs. V. Padmavathi - Safaiwala

BHATKAL FIELD CENTRE

JUNIOR TECHNICAL ASSISTANT

T-2

Shri Ganesh Bhatkal

FIELD ASSISTANTS

T-1

Shri R. Appayya Naik
Shri C.H. Vamana Naik
Shri C.G. Ulvekar

CALICUT RESEARCH CENTRE AND ITS FIELD CENTRE

SCIENTISTS

PS

Dr. P.S. Kuriakose

Sr. S

Dr. E.V. Radhakrishnan

S(SG)

Shri K.K. Appukuttan
Shri T.M. Yohannan
Shri G.P. Kumarasamy Achari

S

Shri C.V. Mathew
Shri M. Feroz Khan
Shri P.K. Asokan

TECHNICAL OFFICERS

T-5

Shri C.K. Krishnan
Shri T. Girijavallabhan
Shri K. Soman
Mrs. K. Koumudi Menon
Mrs. S. Lakshmi
Shri K.K. Balasubramanian
Shri K. Nandakumaran
Shri N.P. Kunhikrishnan

TECHNICAL ASSISTANTS

T-I-3

Mrs. V.K. Janaki
Shri V.G. Surendranathan
Mrs. P. Swarnalatha
Shri K.P. Viswanathan
Shri M.P. Sivadasan

FIELD ASSISTANTS

T-1

Shri C. Chandran
Shri M.M. Bhaskaran

ADMINISTRATION

Assistant

Shri B.D. Puthran

Senior Clerks

Mrs. C. Kamalakshi
Mrs. P. Subhadra

Junior Clerks

Shri R. Sreenivasan
Mrs. K.P. Shylaja
Shri M. Balaraman

AUXILIARY STAFF

Shri P. Harshakumar - Motor Driver

SUPPORTING STAFF

SSG-IV

Shri M. Ramadasan - Lab Attendant

Shri K. Janardhanan - Fieldman

SSG-III

Shri K. Kumaran - Fieldman

SSG-II

Shri K.E. Joseph Victor	Watchman
Shri K. Chekkutty	"
Shri A. Sivadasan	"

SSG-I

Shri T. Haridasan	Fieldman
Shri T.P. Renil Kumar	"
Shri P. Dassan	"
Shri T. Koman	"
Shri M.K. Chandran	Safaiwala
Miss P. Renuka	"
Shri K.T. Mohanan	Messenger
Shri B. Raju	"
Shri P.K. Suresh Babu	Watchman
Shri Palaniappan	Safaiwala

CANNANORE FIELD CENTRE

TECHNICAL ASSISTANT

T-I-3

Shri K. Chandran

JUNIOR TECHNICAL ASSISTANT

T-2

Shri K.C. Purushothaman

VIZHINJAM RESEARCH CENTRE

SCIENTISTS

Sr. S

Dr. P.A. Thomas
Dr. N. Ramachandran

S(SG)

Mrs. Rani Mary George
Shri K. Prabhakaran Nair
Shri G. Gopakumar
Shri S. Krishna Pillai

S(SS)

Dr. P. Kaladharan

S

Shri K.K. Philipose
Mrs. S. Jasmine

TECHNICAL OFFICERS

T-5

Shri R. Vasanthakumar
Shri T.G. Vijaya Warrier
Shri Jacob Jerold Joel
Shri S.G. Vincent
Shri R. Bhaskaran Achari
Shri Ramakrishnan Nair
Shri P.S. Sadasivasarma
Shri Thomas Teles - Bosun

TECHNICAL ASSISTANTS

T-II-3

Shri D. Sundararajan

T-I-3

Shri A.K. Velayudhan
Ms. T.A. Omana
Shri K.T. Thomas
Shri K.C. Gopalan - Cook (Boat)
Shri P. Hillary - Sr. Deckhand
Shri V.P. Benziger - Sr. Deckhand
Shri V. Maria Alwaris - Sr. Deckhand
Shri P.B. Hariharan - Deckhand
Shri S. Ramachandran Nair - Motor Driver

JUNIOR TECHNICAL ASSISTANT

T-2

Shri K. Sasidharan Pillai

ADMINISTRATION

Assistant

Shri M. Regunathan

Senior Clerk

Shri S. Erishikesan

Junior Clerks

Shri C. Johnson
Shri S. Radhakrishnan

SUPPORTING STAFF

SSG-IV

Shri K. Kunjukunju
Shri V. Sasidharan Pillai
Shri J. Ansalem

SSG-III

Shri A. Ayyappadas - Peon

SSG-II

Shri B. Prabhakaran - Messenger
Shri S. Antony - Messenger
Shri V. Kochunarayanan Nair - Watchman
Shri V. Viswanathan - Watchman
Shri R. Madhusudanan Nair - Watchman
Shri K. Chandran - Safaiwala

TUTICORIN RESEARCH CENTRE AND ITS FIELD CENTRE

SCIENTISTS

PS

Shri R. Marichamy

Sr. S

Dr. D.B. James
Dr. M. Rajamani
Dr. M. Mohamed Kasim
Dr. A.C.C. Victor

S(SG)

Shri D.C.V. Easterson
Shri A. Chellam
Shri P. Muthiah
Shri K. Ramadoss
Shri S. Dharmaraj
Shri D. Sivalingam
Shri V.S. Rengasamy

S

Mrs. Rani Palanisamy
Mrs. M.C. Arunmozhi Devi

TECHNICAL OFFICERS

T-6

Shri A. Bastian Fernando

T-5

Shri T.S. Balasubramanian
Shri C.T. Rajan
Shri Agastheesa Pillai Mudaliar
Shri R. Gurusamy
Shri N. Ratnasami
Shri P. Ferozkhan - Bosun

T-4

Shri N. Deivendra Gandhi
Shri Joseph Xavier Rodrigo

TECHNICAL ASSISTANTS

T-II-3

Shri J.R. Ramalingam

T-I-3

Shri N. Jesuraj - Skin diver
Shri F. Soosai V. Rayan - Skin diver
Shri A. Dasman Fernando - Skin diver
Shri B. Sivanandan - Cook (Boat)
Shri D. Anandan - Deckhand
Shri R. Arockiaswamy "
Shri S. Enasteen "
Shri Xavier Mohandas - Motor Driver
Shri M. Enose
Shri K. Srinivasagam
Shri M. Chellappa
Shri G. Arumughan
Shri S. Rajapackiam
Shri O.M.M.J. Habee Mohamed
Shri M. Selvaraj
Shri M. Manickaraja

T-2

Shri S. Mohammed Sathakkathullah
Shri K. Shanmughasundaram
Shri R. Athipandian
Shri S. Sekar V. Rayer - Skin Diver
Shri P. Muthukrishnan - Skin Diver

FIELD ASSISTANTS

T-1

Shri R. Ponniah - Electrician
Shri U. Jayaram
Shri J. Padmanathan

ADMINISTRATION

Superintendent

Shri J.M. Vaz

Assistant

Shri D. Gnanajebamani

Senior Clerk

Shri B. Bavanandam

Junior Stenographer

Smt. S. Leelavathi

Junior Clerks

Miss. S. Sarada
Smt. C. Rajeswari
Shri M. Samuthiram
Shri S. Muthumari
Shri C. Jayakanthan

AUXILIARY STAFF

Shri S.K. Gurusamy - Motor Driver

SUPPORTING STAFF

SSG-IV

Shri A. Francis - Laboratory attendant

SSG-III

Shri M. Alfred - Watchman
Shri D. Motcham - Daftry

SSG-II

Shri V. Samayamuthu - Watchman
Shri R. Uchimahali - Fieldman
Shri K. Thangaraja - Watchman
Shri P. Muthumalai - Watchman

SSG-I

Shri P. Kandan Fieldman
Shri K. Muthuvel "
Shri W. Sathyawan Neelraj "
Shri G.S. Rajappan "
Shri M. Sankaran "
Shri K. Subramanian - Safaiwala
Shri G. Kosalram - Watchman
Shri K. Murugan - Watchman
Shri M. Kalimuthu - Watchman
Shri M. Soundarapandian - Safaiwala
Shri M. Mariappan
Shri S. Alagesan
Shri I. Ravindran
Shri K. John James - Gardner

CAPECOMARIN FIELD CENTRE

T-5

Shri I.P. Ebenezer

T-I-3

Shri A. Prosper

T-1

Shri P. Paul Sigamony

MADRAS RESEARCH CENTRE AND ITS FIELD CENTRES

SCIENTISTS

PS

Dr. K. Satyanarayana Rao

Sr. S

Dr. R. Paul Raj

Dr. P. Devadoss
Dr. P. Nammalwar
Dr. E. Vivekanandan
Dr. M. Vijayakumaran
Dr. P.V. Sreenivasan
Dr. M. Rajagopalan

S(SG)

Shri R. Thiagarajan
Shri M.M. Meiyappan
Dr. V. Thangaraj Subramanian
Shri P. Natarajan
Shri N.S. Radhakrishnan

TECHNICAL OFFICERS

T-6

Shri P.K. Mahadevan Pillai

T-5

Shri K.S. Krishnan
Shri P. Ramadoss
Shri S.K. Balakumar
Shri M. Mohamed Sultan

T-I-3

Shri V.S. Gopal
Shri P. Thirumilu
Shri S. Chandrasekhar
Shri K. Shahul Hameed
Shri C. Manimaran
Shri G. Srinivasan
Shri P. Poovannan
Shri S. Seetharaman
Shri S. Subramani
Shri H. Kather Batcha
Shri L. Jayasankaran
Shri U. Alagumalai - Bosun
Dr. R. Thangavelu
Shri Vali Mohammed - Cook (Boat)
Shri D. Padmanathan - Driver (Boat)
Shri C. Manibal - Deckhand
Shri K. Pandi - Motor Driver
Shri K. Ratnakumar - Motor Driver

T-2

Shri A. Ahamed Kamal Basha

ADMINISTRATION

Assistants

Shri K.M. Karuppiah
Shri S. Mangalam

Senior Clerks

Shri S.K. Murali
Mrs. M. Parvathy
Mrs. G. Abitha
Shri S. Balasubramanian

Stenographer

Mrs. Rosy Jochim

Junior Clerks

Mrs. A.B. Lalitha
Mrs. P. Thankaleelal

AUXILIARY STAFF

DECKHANDS

Shri S. Selvanidhi
Shri V. Joseph Xavier

SUPPORTING STAFF

SSG-III

Shri R. Ananda Jyothi - Watchman
Shri M. Vellayan - Lab attendant

SSG-II

Shri T. Mahalingam - Watchman
Shri G. Chakrapani "
Shri A. Janakiraman "
Shri D. Pakkiri
Shri M. Ravindran - Messenger
Shri G. Vijayarangam - Safaiwala

SSG-I

Shri M. Chandrasekhar Safaiwala
Shri Imbamani "

SSG-I

Shri R. Vasu Field man
Shri R. Sunder "
Shri V. Manoharan "
Shri V. Sitaramacharyalu - Helper
Shri S. Yuvarajan - Lab Attendant
Mrs. Anjali Devi - Peon
Shri M. Anbu - Messenger
Shri P. Selvaraj - Safaiwala

CUDDALORE FIELD CENTRE

T-I-3

Shri A. Srinivasan
Shri T. Dandapani
Shri M. Radhakrishnan
Shri M. Manivasagam

PONDICHERRY FIELD CENTRE

TECHNICAL ASSISTANT

T-I-3

Shri L. Chidambaram

MAHABALIPURAM FIELD CENTRE

TECHNICAL OFFICER

T5

Shri S. Manivasagam

ONGOLE FIELD CENTRE

TECHNICAL OFFICER

T-5

Shri K.V.S. Seshagiri Rao

TECHNICAL ASSISTANT

T-4

Shri A. Hanumantha Rao

FIELD ASSISTANT

T-I

Shri G. Sudhakar
Shri N. Boominathan

NELLORE FIELD CENTRE

TECHNICAL OFFICER

T-5

Shri G.C. Lakshmiah

FIELD ASSISTANT

T-1

Shri S. Rajan

KOVALAM FIELD CENTRE

TECHNICAL ASSISTANT

T-I-3

Shri S. Sankaralingam

KAKINADA RESEARCH CENTRE AND ITS FIELD CENTRES

SCIENTISTS

PS

Shri G. Subbaraju

Sr. S

Dr. G. Syda Rao

S(SG)

Shri A. Raju

S

Miss K.N. Saleela

TECHNICAL OFFICERS

T-8

Shri B.S. Ramachandrudu

T-5

Shri P. Ramalingam

TECHNICAL ASSISTANTS

T-4

Shri K. Dhanaraju
Shri K. Ramasomayajulu

T-I-3

Shri K. Dharma Rao - Motor Driver
Shri C.H. Ellithathayya

T-2

Shri T. Negeswara Rao

FIELD ASSISTANTS

T-1

Shri P. Venkatarama
Shri N. Burayya
Shri Vasamsetty Abbulu
Shri P. Achayya

ADMINISTRATION

Senior Clerk

Shri S. Suryanarayana Murty

Junior Clerk

Shri S. Appa Rao

SUPPORTING STAFF

SSG-IV

Shri K. Narasimhamurty - Lab attendant

SSG-II

Shri R.V.S. Subramanyam - Watchman
Shri S. Tatabbai - Messenger

SSG-I

Shri D. Bhaskara Rao - Safaiwala
Shri G. Sainyadhipathi - Watchman
Shri K. Satyanarayana - Watchman

NARASAPUR FIELD CENTRE

TECHNICAL OFFICER

T-5

Shri P. Ananda Rao

MACHILIPATNAM FIELD CENTRE

TECHNICAL ASSISTANT

T-I-3

Shri T. Chandrasekhara Rao

VISAKHAPATNAM RESEARCH CENTRE AND ITS FIELD CENTRES

SCIENTISTS

PS

Dr. G. Luther
Dr. V.S.K. Chennubhotla

Sr. S

Dr. G. Sudhakara Rao

S(SG)

Shri R. Sarvesan
Shri G. Mohanraj
Shri K.M.S. Ameer Hamsa

S

Shri K. Vijayakumaran

TECHNICAL OFFICERS

T-5

Shri C.V. Seshagiri Rao
Shri M.V. Somaraju

TECHNICAL ASSISTANTS

T-4

Shri K. Chittibabu

T-II-3

Shri K. Diwakar
Shri T.N. Sukumaran - Bosun

T-I-3

Shri M. Samuel Sumithrudu
Shri J. Bhuvaneswara Varma
Shri M. Chandrasekhar
Shri Sailada Satya Rao
Shri K. Narayana Rao
Shri M. Prasada Rao
Shri P.A. Reghu - Oilmen-cum-Deckhand
Shri P.M. Abdul Muheedu - Deckhand

T-2

Shri S. Chandrasekhar
Shri S. Ganesan - Deckhand
Shri P. Pasupati Rao - Motor Driver

FIELD ASSISTANT

T-1

Shri R.V.D. Prabhakar

AUXILIARY STAFF

Shri S. Durai Pandian - Motor Driver
Shri R. Balakrishnan - Deckhand

ADMINISTRATION

Assistant

Shri R. Appa Rao

Senior Clerk

Shri K. Shanti Prasad

Junior Clerks

Mrs.. B. Gauri
Miss. B. Madhavi Latha

SUPPORTING STAFF

SSG-IV

Shri V. Mohana Rao - Lab attendant

SSG-II

Shri L. Appa Rao Messenger
Shri V. Demudu "
Shri R. Kankaraju "
Shri P. Krishna Rao - Watchman
Shri R. Dalayya - Safaiwala

SRIKAKULAM FIELD CENTRE

JUNIOR TECHNICAL ASSISTANT

T-2

Shri N.P. Chandrakumar

PALASA FIELD CENTRE

TECHNICAL ASSISTANT

T-I-3

Shri V. Achutha Rao

GOPALPUR FIELD CENTRE

FIELD ASSISTANT

T-1

Shri Satchidananda Nayak

CONTAI FIELD CENTRE

TECHNICAL ASSISTANTS

T-I-3

Shri Sapan Kumar Ghosh
Shri Pulin Behari Day

T-2

Shri Bijay Krishna Burman

FIELD ASSISTANT

T-1

Shri Swapan Kumar Kar

PURI FIELD CENTRE

TECHNICAL ASSISTANTS

T-I-3

Shri P. Venkatakrishna Rao
Shri Sukdev Bar

FIELD ASSISTANT

T-1

Shri S. Hema Sundara Rao

MINICOY RESEARCH CENTRE

SCIENTISTS

S(SG)

Shri Pon Siraimeetan

S(SS)

Shri M. Sivadas

S

Smt. P.T. Sarada
Shri A.K.V. Nassar

TECHNICAL ASSISTANT

T-II-3

Shri V.A. Kunhikoya

T-1

Shri A. Anasukoya

ADMINISTRATION

Junior Clerk

Mrs. M. Safiyabi

SUPPORTING STAFF

SSG-IV

Shri C.M. Rajappan - Lab attendant
Shri P.I. Koya - Watchman

SSG-III

Shri C. Mohamed Koya - Lab attendant

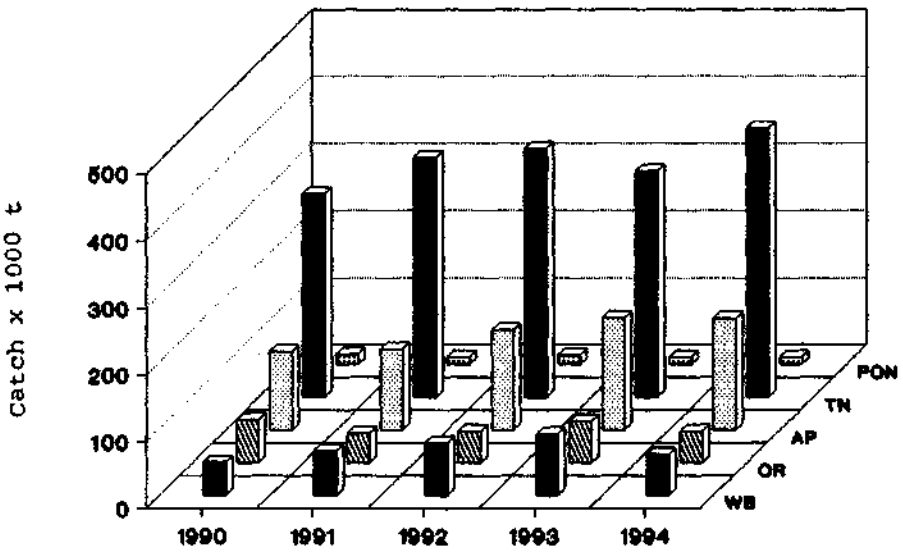
SSG-II

Shri N. Pookoya - Watchman

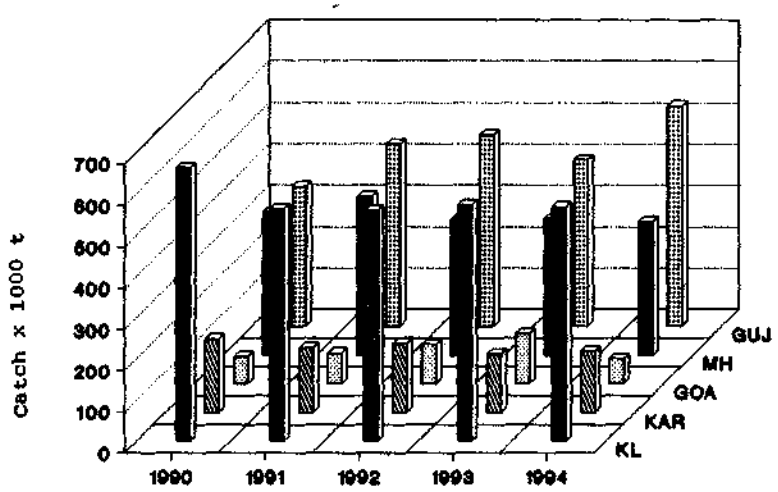
Shri O.M. Ismail - Watchman

SSG-I

Shri M.P. Mohamed Khaleel - Fieldman



Marine fish landings in different states along the east coast of India during 1990 - '94
(WB: West Bengal; OR: Orissa; AP: Andhra Pradesh; TN: Tamil Nadu; PON: Pondicherry)



Marine fish landings in different states along the west coast of India during 1990 - '94
(KL: Kerala; KAR: Karnataka; MH: Maharashtra; GUJ: Gujarat)

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